POULTRY FARMING FOR PROFIT

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PREFACE

THE SCIENCE OF COMMERCIAL POULTRY FARMing is based on methods that have proved successful in the laboratory and on experimental farms. The primary purpose of this book is to supply the poultryman with sound principles of flock management and to illustrate the application of such principles to everyday farm problems.

"*Poultry Farming For Profit*" may be divided into three main parts. First, the establishment of a poultry farm. Second, all phases of management from the purchasing of baby chicks to the culling of old hens. Third, poultry diseases, their causes, symptoms, treatment, and prevention. Because disease is the greatest single cause of reduced profits and farm failures, particular emphasis has been placed on the problems of maintaining a healthy, and therefore profitable, flock.

The author extends gratitude to those people who have helped make the preparation of this book a pleasant task: to poultry farmer friends for their suggestions and practical hints; to personnel of the agricultural schools, extension services, commercial laboratories, and the United States Department of Agriculture, who have given liberally of their time and provided the book with photographs. Credit for the original line drawings goes to my wife, whose patience and talent have made this book possible.

J. J. H.

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INTRODUCTION

THIS YEAR AND EVERY YEAR, A NUMBER OF INexperienced men will go into the business of raising chickens for eggs or meat. Some of those who set out will fall by the wayside, sadder, perhaps wiser, and minus a sizeable sum of money. Others with foresight and through careful planning will settle down to "Poultry Farming for Profit."

What factors determine success or failure in the business of poultry farming? To succeed you must be prepared to work long hours when necessary, seven days a week. *There is no such thing* as a 40-hour week (or a guaranteed annual wage) in poultry or any other type of farming. You must keep accurate farm records that show at a glance how much feed the flock is consuming; how many birds have been lost or culled during the brooding, growing, and laying seasons; and how many eggs or pounds of meat have been sold, and at what price and what grade. Farm records also are helpful in computing state and federal income tax returns. Finally, a carefully kept set of books will show you exactly how your business has fared and *at what points it can be improved.*

Careful planning is another important requirement of a well-organized and profitable enterprise. Last minute arrangements usually lead to hit or *miss results and a decline in profits. The purchase and installation of* new equipment, the ordering of day-old chicks long before the start of the brooding season, the plowing and planting of range—these are a few of the jobs that require careful, advance planning.

A continuous study of new and improved methods of poultry farming is recommended. Plan to attend local poultry meetings, poultry expositions, and conventions. Keep informed on poultry research and development by reading some of the excellent poultry periodicals that are available. (Some are listed on Page 12.) Subscriptions for these magazines are reasonably priced. Write for bulletins and pamphlets that are published by the United States Department of Agriculture and the extension service departments of state agricultural colleges. Trends in feeding, disease control, housing, marketing, and other phases of poultry husbandry are reported in these valuable publications.

Experience is still the best teacher. If possible, learn the poultry business by working for someone else first. Attend classes at an agricultural school or college. (Many give correspondence and evening adult education courses.) If you decide to go into business without first acquiring experience, remember to move slowly and learn while you work. You will need to become fa-

miliar with the principles of housing, brooding, feeding, culling, and disease control as quickly as possible. Lack of experience should not stand in your way, providing you are willing to study as you farm and are able to apply *common sense* to the everyday problems of poultry husbandry.

Whether or not you enjoy your work may prove a prime factor in determining your success or failure. You and your family will discover that poultry farming is more than a means to an income. *It is a way of life.*

PART I

PLANNING THE FARM

Chapter 1

CHOOSING A POULTRY FARM

THERE ARE MANY QUESTIONS THAT FACE THE man who wants to start a poultry farm. What type and size farm should he buy? Or should he rent? How much cash is needed? What are the requirements for securing credit? Is it better to purchase a large farm or start on a small scale and expand as conditions permit? Is there a minimum number of birds required for effective and profitable production of meat or eggs? In the opening chapters we have set down recommendations and suggestions—some specific and some general—that will help answer these questions and others raised by inexperienced poultry farmers.

TYPES OF FARMS

The Commercial Egg Farm. Two thousand or *more* layers make for one of the most desirable types of poultry operations. A well-managed egg farm with a sufficient number of high production hens should yield a satisfactory income despite falling egg prices or rising feed costs. Two thousand birds may be handled by one man with some part-time help or occasional assistance from other members of the family.

Two alternatives are suggested for acquiring a commercial-sized egg farm. Purchase an established farm with the size and capacity you can afford *or* build your own business by putting up new houses, buying new equipment, and stocking the farm with day-old chicks. Then build the flock up to 2,000 or more birds. If sufficient capital is available, starting a "new" farm is probably the ideal approach. Constructing new buildings on clean land will enable you to give your flocks a chance for a disease-free start in life. Disease losses often spell the difference between profit and loss in a new farming venture. Furthermore, the construction of a new plant enables

you to take advantage of the latest developments in housing plans and the newest designs in equipment.

The cost: Starting a 2,000-hen-capacity farm is estimated to cost between $8 and $12 per bird. This will include the cost of the land, the constructing and equipping of brooding and laying houses, and approximately $2 for the cost of raising each pullet chick to maturity. With today's real-estate prices and construction costs, you will need $20,000 to $24,000 in cash or credit before you gather your first basket of eggs. If your cash reserves are low and your credit somewhat limited, it may be wise to begin with fewer than 2,000 birds and increase the size of the flock as time and money permit. Supplementary income derived from an outside job may help to make possible the transition from a small, part-time flock to a commercial egg farm.

The purchase: An established poultry farm with a capacity of 2,000 to 2,500 layers may cost from $20,000 to $25,000 *or more*. The final purchase price will depend on the location of the farm, the amount and quality of the acreage, and the type and condition of the farm buildings, including the family dwelling. A farm valued at $20,000 will probably require a minimum down payment of $5,000. In addition to the down payment, you should have another $6,000 in cash or credit to cover your personal living expenses, mortgage payments, and the cost of operating the farm for a period of 12 to 18 months. If the farm and its equipment are in good condition, *and* if it is stocked with productive, disease-free birds, some profits may be realized within a few months. However, unless you are exceptionally skillful or blessed with a streak of good luck during your first year and a half of farming, be prepared to operate on little or no profit. If you are prepared for the worst, the best will come as a pleasant surprise.

Before you buy an established farm, carefully determine the condition and quality of the plant and its physical assets. For example, are you acquiring sound buildings and usable equipment, or are the houses in need of major repairs and the equipment obsolete and useless? Are you buying a "clean place" or will you inherit poultry disease problems that cannot be solved easily? Do not conclude your purchase of a poultry farm without first consulting an experienced poultryman or veterinarian familiar with poultry husbandry problems. Some of the points to consider when examining buildings, birds, and equipment are as follows:

Condition, age, and quality of stock: The price of any poultry stock you consider buying should be determined by the physical condition of the birds, the number of months they have been in production, the presence or absence of disease or parasites, and *an estimation of the bird's future production*. A well-bred, ready-to-lay pullet (four or five months old) is worth from $1.75 to $2. Younger birds may vary in price from as little as 50 cents for a 2-week-old chick to $1.50 for a 3 and one-half to 4-month-old pullet. (*See Chart 1.*) If possible, determine the source of the stock. Flocks that have not been bred for high production are poor investments. (*See Page 30.*)

Old hens and culls (birds no longer in production) should be disposed of by the present owner before you take over the property. The health of the flock is an important consideration. If there is any evidence of respiratory diseases—including air sac infection or coryza—a temporary depopulation of the premises may be advisable. (*See Page 179.*)

CHART 1

APPROXIMATE COST OF RAISING A PULLET TO MATURITY

Cost of Chick	$ .40	*A sexed, day-old pullet chick from a well-bred, high* production strain.
Feed to 6 Months	1.20	Approximately 24 pounds at 5 cents a pound. (*Substi*tute current feed prices to arrive at a more exact figure.)
Your Labor	.20	10 per cent of the cost of raising each pullet constitutes payment for your own labor.
Outside or Family Labor	.10	A well-equipped, well-organized 2,000-bird farm may require no outside labor.
Vaccination	.05	This figure includes pox, tracheitis, bronchitis, and Newcastle vaccinations.
Mortality	.10	*Including depreciation and culling of chicks.* Chick mortality may increase if there are excessive vaccination losses or disease outbreaks.
TOTAL	$2.05	

Condition and layout of buildings: Be sure the buildings are in good condition and are large enough to house the number of layers you plan to raise. Under average conditions, a minimum of 3 square feet per layer is needed for light breeds and 3 and one-half to 4 square feet for heavy breeds. Measure floor space of brooding and rearing pens and laying houses to determine the over-all housing capacity.

Since electric power is necessary for efficient management, all houses should be wired for electricity. The value of the buildings is also enhanced if floors and foundations are made of concrete and are in sound condition. Insulation will help reduce feed and fuel costs. Make certain the floors of laying and brooding pens are not damp. A dry pen is usually a healthy pen.

Egg rooms or cellars should be large enough to hold at least three days' egg production. Mechanical refrigeration is a definite asset. (*See Figure 1.*) Houses should be arranged for economy of movement in completing routine chores.

Condition and type of equipment: Metal feed hoppers are desirable. They lend themselves to thorough cleaning and will last longer than wooden hoppers if cared for properly. If mechanical feeding equipment is available, it will contribute greatly to your labor efficiency. Running water in pens will save many steps. Automatic water fountains are a must for a well-run com-

mercial farm. Metal nests in the laying pens are preferable to wooden ones that may be infested with mites. Be sure all brooding equipment and other farm machinery is in working order or can be used safely until repair or replacements are possible.

The Farm Flock. If you are now engaged in another type of farming, you might consider raising a small flock of birds to augment your regular in-

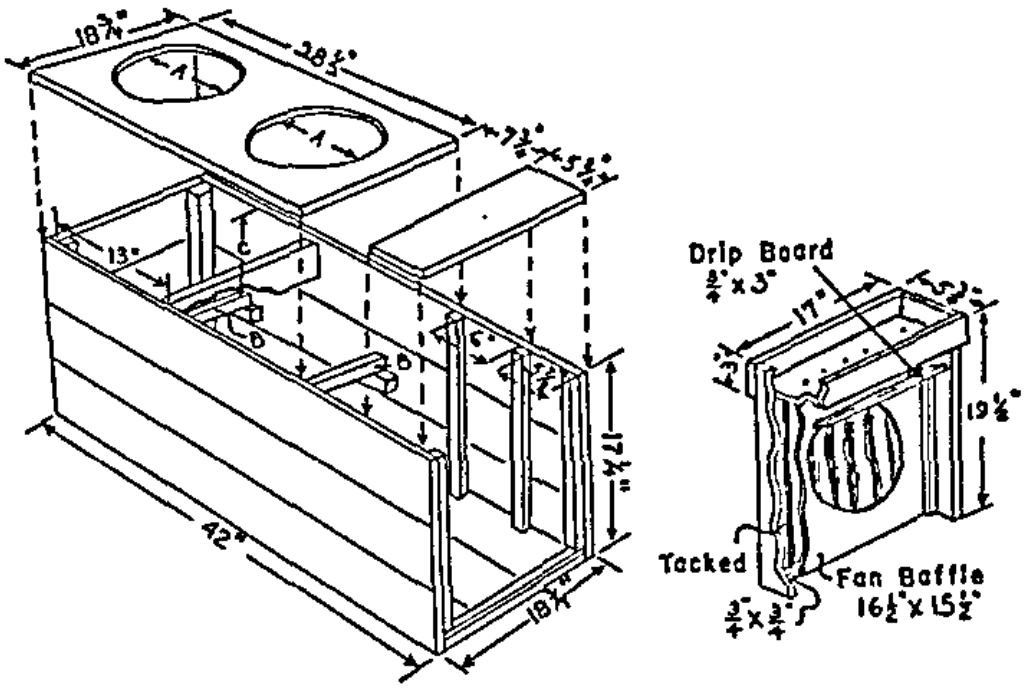

Fig. 1. Rapid cooling is conducive to the marketing of high quality eggs. This mechanical egg cooler may be constructed easily on the farm. A household-size electric fan is used as a source of cold air, and lampwicks or burlap strips are used to absorb moisture from the water trough to help maintain a high humidity in the cooler. The fan end of the unit is left open so that the fan may be removed and used elsewhere when the cooler is not in use. (Courtesy of the R.E.A., United States Department of Agriculture.)

come. Many fruit, vegetable, grain, and livestock farms maintain flocks of *500 or more* birds. If labor and space is available, the farm flock will provide a dependable source of supplementary income.

The Back-Yard Flock. Such a flock should consist of *not more than 50 birds*. Larger flocks are liable to become more of a financial burden than a profitable hobby. A back-yard flock should not be expected to produce revenue; instead it should provide a ready source of fresh eggs and poultry meat for the family table and freezer. These figures are worth remembering: 50 birds for the back-yard flock; at least 500 birds for the farm flock; and 2,000 birds or more for the commercial flock.

Commercial Broiler Production. A minimum output of 150,000 pounds of meat, or 50,000 birds a year is called for. This number of birds is usually produced by raising four separate broods of 12,000 to 13,000 at regular, three-month intervals. Farms marketing 100,000 birds or more annually are

common in concentrated broiler-raising areas of the country. Broiler production has three main attractions: fast profits (*birds are marketed in 10 to 12 weeks*); relatively low capital investment for buildings and equipment (*75 cents to $1 per bird capacity*); and liberal credit sources (*from feed companies and hatcheries*). The illusion of quick profits with little capital risk frequently attracts inexperienced men into the broiler industry. This results in occasional periods of overproduction and depression of the poultry meat market. *Broiler farming has become a highly specialized and competitive industry. To maintain a stable and profitable business, you must be prepared to apply top management efficiency to a large volume output.*

The Combination Egg and Meat Farm. On a commercial scale such a combination is not advisable for either the beginning or experienced farmer. A divided interest in poultry management generally results in a divided and somewhat reduced income. A few out-of-season broilers or fryers raised along with laying flocks may be considered if additional building space and labor are available, and if the meat production program does not interfere with the management of your laying flocks. If straight-run broods (*pullets and cockerels combined*) are raised on the commercial egg farm, the sale of surplus cockerels as broilers or fryers will help defray rearing costs. Choose one field of endeavor and concentrate on it. You are either a successful egg man with a few broilers to sell, or a broiler grower with a few layers to keep your family supplied with fresh eggs. Poultry specialization can help the low margin of profit pennies add up to net income dollars.

Hatcheries and Breeding Farms. Poultry breeders and hatcherymen specialize in the production of replacement stock for broiler and laying flocks. The operation of a commercial breeding farm or hatchery calls for extensive background in the principles of poultry husbandry and the everyday application of sound business judgment. Do not consider purchasing or running a hatchery until you have acquired a thorough knowledge of broiler and egg production and have first-hand experience in breeding farm and hatchery management.

The One-Man Farm. With 2,000 hens or 50,000 broilers, a one-man farm will provide an approximate income of $3,500 to $5,000 a year. This is the sum that remains after all operating costs, including depreciation and a 5 per cent return on your capital investment, have been deducted. Large families should plan to keep at least 800 hens or 16,500 broilers for *each* member of the family. Thus, a family of four would strive for a farm capacity of 3,200 hens or 66,000 broilers a year. Larger one-family operations can be managed with the help of labor-saving devices, such as mechanical feeders and automatic waterers.

The Two-Man Farm. The farm that earns enough to support more than one family has many advantages in management efficiency, as well as in personal comfort. The two-man operation, with its combined investment, provides for vacations and emergency relief; an increase in egg or meat output

and plant capacity (*more than double the amount handled by one man*); and discount savings through quantity and cash purchases. If you and your prospective partner have a sound basis for a personal and business association, it may be advantageous to pool your resources. Partnership agreements should be drawn up by an attorney and should include a detailed description of distribution of equity, division of profits, option rights, and similar points. Do not rely on verbal agreements. Too many friendships, including some between father and son, have been broken by misinterpretation of unwritten contracts.

The Cycle of Poultry Profits. Usually profits follow a fairly well-defined pattern. During the profit-making years, new men are anxious to buy or build poultry farms. At the same time, the established poultry farmer, expecting a continuation of profitable production, increases the size of his broods and may begin constructing new buildings. In six months to a year the production of the new and expanded flocks reaches the market and prices drop. If feed and other farm expenses either remain fixed or rise during this period, poultry profits must inevitably decrease. The profit cycle reaches its low mark and newcomers to the business who are caught with little or no reserve capital may be forced to offer their farms for sale. Should you decide to buy your poultry farm on a deflated real estate market, be prepared for a tight rationing of your reserves. Your farm may not show a profit for as long as 18 months. Success during a period of unfavorable egg-feed ratios depends to a large extent on management efficiency. If flocks are rigidly culled and egg production is maintained at 60 per cent or more, if feed is not wasted, *and* if disease losses are kept at a minimum, a poultry business, whether new or old, will survive the cycle of poultry profits.

CHOOSING A LOCATION

Before you buy, rent, or build a farm you must decide where you want to farm. You may prefer living within commuting distance to the city. Or you may want to get as far out into the country as possible. Before making your final decision, consider the following points: Eggs or broilers produced near large population centers have a decided marketing advantage. However, acreage and feed prices may be higher in these areas. Adequate transportation facilities are needed for easy delivery of supplies to the farm and for moving eggs, broilers, and cull hens from farm to market. (A farm located on a well-traveled road may lend itself to a retail, roadside business.) Some attention must be paid to the proximity of schools, churches, and shopping centers.

Investigate Zoning Restrictions. They apply to your farm, particularly if you are located in the path of a rapidly growing city. The construction of private homes near your property may result in unexpected complications in the nature of official complaints about flies and odors. It is best to avoid

possible difficulties by buying sufficient acreage, preferably in a predominantly agricultural area.

What Is the Local Labor Situation? If you are farming close to an industrial section, competent help may be difficult to obtain. Few farmers can afford to compete with the wages offered to industrial workers. In some cases, student help may be utilized during after-school hours and on weekends. Partners, grown or growing children, and wives often eliminate the need for outside assistance.

How Much Land Will You Need? A commercial poultry farm can be successfully organized on as little as one acre. However, a two or three-acre plan is preferable. If a range system of management is contemplated, three acres should be allowed for every 300 pullets raised to provide for an adequate range rotation program. (*See Page 52.*) Don't skimp on acreage. It is better to have some land standing idle than to find yourself cramped for space when you're ready to expand.

Negotiating the Purchase of Farm Property. Before making your purchase, you should determine if the price being asked is a fair one, and *whether your mortgage payments can be carried by the business.* Make certain that there are no liens against the property or defects in the deed that might cause future legal entanglements. Title clearance and allied services are performed by your local bank officials, your attorney, or authorized escrow agents. Escrow entails the transfer of the deed to a third party (*a bank, title company, or building and loan company*) until certain stipulated conditions have been met by the present and future owners of the property. The fees for escrow service are usually divided between the parties involved in the sale. Other costs, such as those involved in surveying the land or search of the title, are borne by you as the prospective owner. Escrow agents or your attorney will help clarify any questions pertaining to right of way and water, mineral, and utility rights. Don't rely on your own skill in handling real estate transactions. Retain the services of a qualified agent to protect your interests. Your future security may depend on it.

Chapter 2

HOW TO OBTAIN CREDIT FOR FARMING

GOVERNMENT AS WELL AS PRIVATE SOURCES of credit are available to either the beginning or the established farmer. Of course, the more extensive your practical farming background is, the greater your credit opportunities are. Long-term loans are usually sought for the purpose of buying or improving farms, land, or buildings. Short-term credit may be used to purchase feed supplies and to help finance broiler or fryer flocks until they are marketed.

Local commercial and savings banks, building and loan associations, and insurance companies may extend mortgage credit on 50 per cent of the original purchase of the farm or 60 per cent of the true value of the property. This includes the value of the land and buildings, but not the livestock. Mortgage interest rates vary from 4.5 to 6 per cent.

Federal Land Bank Loans. Supervised by the 12 District Land Banks of the Farm Credit Administration, these loans are available for purchasing farm property. The loans are handled by the local branch offices and representatives of cooperative National Farm Loan Associations. The staff of the National Farm Loan Association office in your community will help you prepare an application for the loan and a local committee will study your qualifications for mortgage credit. To qualify, you should be able to show proof that you are, or will be, engaged in a farming operation, or that the principal part of your income is derived from farming; demonstrate that you possess some knowledge of poultry husbandry and farming principles; show that the farm is of sufficient capacity to produce a net income that will support your family, pay operating expenses, and provide for annual or semiannual mortgage payments; show your ability and willingness to establish a fair equity in your farm (*a minimum down payment of 20 per cent of the assessed valuation of the property*); and provide the association with a list of companies, banks, or individuals who can attest to your credit rating. Any outstanding debts or credit failures incurred in the past may weaken your chances of obtaining farm credit.

When you have satisfied National Farm Loan Association personnel of your credit qualifications, your application may be approved, the local office assuming responsibility for the loan you receive. As a demonstration of your good faith, you are then asked to purchase stock in the association equal to 5 per cent of the amount of your loan. The cost of this stock may be included in the total sum of money you borrow. The stock entitles you to a vote and voice in running the local farm-loan group. When you have repaid your loan *in full, your stock is redeemed at par value. Membership in the* National Farm Loan Association is limited to those farmers who have borrowed money from the Federal Land Bank.

The terms of Federal Land Bank mortgage loans are as liberal as any you will be able to negotiate with other lending agencies. Payments are amortized and combine principal and interest in one payment. They come due annually or semi-annually. Interest on the *unpaid balance* ranges from 4 to 4.5 per cent. Loans may be paid back over a period of from 20 to 34 and one-half years. The maximum amount of mortgage money granted will be 65 per cent of the value of the farm, based on an official appraisal of the farm and its productive capacity. No loan may exceed $50,000. For further information about Federal Land Bank loans, write or telephone the National Farm Loan Association office nearest you, or write to the District Land Bank serving your state. (*A list of addresses is found on Page 13.*)

The Farmer's Home Administration. The farm purchase program of this organization is intended to help men with agricultural experience obtain sufficient capital to buy their own farms. Application for a first mortgage loan may be made through the Farmer's Home Administration local offices. These loans, with interest rates of 4 to 5 per cent, may be repaid over a period up to 40 years. Committees, usually made up of your farmer-neighbors, will consider the following factors in deciding if you are eligible for an F.H.A. loan:

1) Have you had some farming experience, preferably in the type of enterprise you are about to undertake? 2) Are you unable to obtain mortgage credit from any other source at interest rates of 5 per cent or less? 3) Will the loan be used for the purchase of farm property or for improvement of a farm you now own? 4) Is the farm capable of showing a profit that will enable you to meet amortized payments on your loan? 5) Is farming to be your main source of income? 6) Is the farm's value comparable to the average family-type farm in your county?

Loans granted by the Farmer's Home Administration may not exceed $12,000, nor is credit allowed for part-time farms. Disabled veterans, however, are allowed F.H.A. mortgage loans on part-time farms if their disability allowance is sufficient to make up the difference between the amount earned on the farm and the sum required to pay production expenses and meet mortgage payments.

Although an initial down payment is not necessary to qualify for a loan,

Farmer's Home Administration officials will encourage you to establish some equity in the property at the time your application is presented.

Short-Term Credit. For purchasing feed or livestock or to cover living expenses, short-term loans may be secured from the Farmer's Home Administration, with interest rates figured at 5 per cent for a period of time not to exceed five years. Production credit also is available from local Production Credit Administration offices. (*See next paragraph.*) For further information regarding F.H.A. farm purchase or production loans, contact your county representative or write directly to the Farmer's Home Administration, Washington 25, D.C.

Production Credit Associations. These associations are run by and for the benefit of the practicing farmer. Their express purpose is to provide the qualified farmer with a source of cash for his immediate production needs. Production Credit Association loan terms are reasonable, with low interest rates. The loans may be used for the purchase of feed, baby chicks, fuel, machinery, tractors, trucks, automobile, household appliances, and other items. The money may be used to pay interest on loans, taxes, and wages; for making repairs on machinery; and for repairing or improving home and farm buildings. Interest is charged on the unpaid balance only. Security on Production Credit Association loans is represented in the form of chattel or personal property mortgages on livestock or equipment.

Broiler Production Financing. In recent years feed dealers, hatcherymen, and poultry processing companies have often extended credit to broilermen for the purchase of chicks, feed, fuel, litter, and drugs. In addition to credit, they may offer advice on feeding, disease control, marketing of the birds, and general management of the business. The farmer contributes his skill, labor, land, houses, and equipment to the project. When the birds have been sold, production costs, including interest or carrying charges, are deducted and the remaining profits are divided between the broiler producer and his financier. Any losses are borne by the backer. To the farmer who has limited funds or who is unwilling to risk his own capital, the "sponsored" broiler flock offers obvious advantages. But in spite of the attractions of this type of arrangement, the man who pays for his own production is in the more enviable position. By paying cash for his chicks, feed, and equipment in a competitive field, he may receive liberal discounts on his purchases. And, more important, he is able to plan and guide his own project without outside participation and subsequent profit sharing.

Short-Term Production Loans. In some areas, wholesale egg buyers who want access to a continuous supply of fresh, high quality eggs will extend production credit to a farmer in exchange for the privilege of obtaining all eggs produced. The farmer manages the flock and furnishes the houses, equipment, and labor. All other expenses, including chicks, feed, fuel, litter, and drugs, are assumed by the egg buyer. The farmer's profit consists of a set amount allowed him for each dozen eggs produced.

Some banks may be persuaded to grant production credit up to 90 days to help cover the cost of bringing pullets into lay. The debt usually comes due soon after egg production starts. These short-term, non-real-estate loans seldom are considered good risks; interest rates may therefore be comparatively high.

THE G.I. BILL OF RIGHTS

Veterans of World War II and those who served in the armed forces between June 27, 1950 and January 31, 1955 are eligible for government sponsored schooling, on-the-job training and/or G.I. guaranteed loans for farms, homes, and business enterprises. Educational and training benefits must be used before January 31, 1965 or no later than eight years after separation from active service or the end of the basic service period. To determine your eligibility for these and other benefits, write the Veterans Administration Office, Washington 25, D.C., or inquire at any of its branch offices. When writing, be sure to include your serial number, date of entry into the armed forces, date and type of discharge, branch of the service, and other facts that might be needed to process your papers and supply you with the desired information.

The G.I. Bill of Rights loan guaranty enables you to secure low-interest loans for the purpose of buying a farm or for improving a place you already own. Short-term production loans for purchasing livestock or equipment or for operating the farm are available. The Veterans Administration does not advance the money for the loan. It merely insures payment of low-interest loans extended to veterans by private lending agencies, such as banks and mortgage companies or building and loan associations. The loans are amortized and repayable at interest rates not to exceed 4.5 per cent over a period up to 40 years. The Veterans Administration also will pay the first year's interest on that part of the mortgage that it has guaranteed. The amount guaranteed for a real estate loan may not exceed $7,500, or more than 60 per cent of the total loan. If two eligible veterans form a partnership, each is entitled to a $7,500 loan guaranty toward the joint purchase of a farm. (*Applicable to a husband and wife if both are veterans.*) The maximum amount allowed on non-real-estate loans is $2,000. Non-real-estate loans must be repaid in ten years or less at interest rates that may go as high as 5.7 per cent.

Some farming experience is necessary in order to qualify for a G.I. farm mortgage or farm production loan. Lack of experience may present an insurmountable obstacle in negotiating a farm purchase loan. Thus, every effort should be made to acquire both farming knowledge *and* experience before starting to operate a farm on your own. There are many jobs available on commercial poultry farms to the willing though inexperienced beginner. If you are eligible for schooling benefits under the G.I. Bill of Rights, investi-

gate the opportunities for study at state agricultural schools and colleges. Many of these institutions offer excellent two to four-year courses in poultry and animal husbandry. Correspondence courses, summer courses, and part-time evening classes are given by some colleges and high schools. The Veterans Administration office in Washington or any of its regional offices will supply information about their "on-the-job" farm training programs. Call or write the agricultural agent in your county or the director of the State Agricultural Extension Service for information about farm and educational job opportunities.

ADVICE FOR THE FARMER-TO-BE

1. Read as many books and bulletins as possible on all phases of poultry production.
2. Talk to people in your community who are connected with the poultry industry.
3. Discuss farm purchases or farming problems with your county agent.
4. If possible, acquire farming experience *before* you buy a farm.
5. Contact your local bank, National Farm Loan Association, or the Farmer's Home Administration for help in buying a farm.
6. Try to provide a cash down payment for your farm that will amount to at least 20 per cent of the real or appraised value of the property.
7. Buy or build a farm that has a capacity great enough to support your family, meet your mortgage payments, and still show a nominal profit.
8. Shop around for your credit needs. Remember that mortgage credit is cheap, production credit is expensive.
9. Subscribe to one or more of these excellent poultry farming periodicals:

American Poultry Journal
180 N. Wabash Avenue, Chicago 1, Illinois
Pacific Poultryman
P.O. Box 521, Palo Alto, California
Poultry Digest
Sea Isle City, New Jersey
Broiler Growing
Mount Morris, Illinois
Everybody's Poultry Magazine
Hanover, Pennsylvania
Poultry Tribune
Mount Morris, Illinois

Farmers who wish to obtain land bank loans should apply to the National Farm Loan Association office serving the territory in which their farms are located. If the address of the association or its representatives is not known, a letter to the Federal Land Bank serving your state will bring

the desired information. The cities in which the banks are located and the states they serve are as follows:

SPRINGFIELD, MASS.	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont
BALTIMORE, MD.	Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia, and Puerto Rico
COLUMBIA, S.C.	Florida, Georgia, North Carolina, and South Carolina
LOUISVILLE, KY.	Indiana, Kentucky, Ohio, and Tennessee
NEW ORLEANS, LA.	Alabama, Louisiana, and Mississippi
ST. LOUIS, MO.	Arkansas, Illinois, and Missouri
ST. PAUL, MINN.	Michigan, Minnesota, North Dakota, and Wisconsin
OMAHA, NEBRASKA	Iowa, Nebraska, South Dakota, and Wyoming
WICHITA, KANSAS	Colorado, Kansas, New Mexico, and Oklahoma
HOUSTON, TEXAS	Texas
BERKELEY, CALIF.	Arizona, California, Nevada, and Utah
SPOKANE, WASH.	Idaho, Montana, Oregon, and Washington

Chapter 3

HOUSING THE POULTRY FLOCK

POULTRY HOUSES SHOULD SATISFY CERTAIN basic requirements: they must be durable but relatively inexpensive to build; they should be conveniently arranged; and they must provide comfort during the winter and summer months for both growing and adult flocks. Birds that are comfortably housed reflect their environment in maximum weight gains, increased egg production, and greater resistance to diseases and parasites. The construction, location, arrangement, and possibly the design of your poultry buildings will be determined by such factors as the type of acreage available, the amount of money you want to spend, the proposed size of the flock, and your plans for future expansion.

Terrain. Do not build houses in low spots. Cold air and dampness tend to settle in depressions or gullies. On the other hand, houses placed on high ground may be too drafty. Buildings located on the side of a gently rolling slope will be assured good circulation of air and proper drainage of water. The front of the houses should face the direction of the prevailing warm winds. In most regions this means a southern exposure. However, warm air currents in some sections of the country originate from the southeast or southwest.

Soil. Light, productive, and easily drained soil is ideal for poultry raising. It is true that chickens can be raised on ground that is unsuited for any other agricultural project. But the poultry farmer who starts his flock on clean range or pasture is able to produce healthy pullets at a reduced cost in feed. If acreage on your farm is limited, you should plan to use the 100 per cent confinement system of management (no yards, runs, or range). Houses constructed on hard-packed, clay soils should be provided with a tile or similar type drainage system. If provisions are not made for adequate drainage, chronically damp floors will result.

Buildings. Design and arrange buildings for ease in carrying out routine chores. Economy of movement will mean considerable savings in time and money—time and money that could be used to better advantage in other phases of your poultry business. Here are some suggestions:

1. Arrange houses so that young and growing stock may be taken care of

before the adult birds are handled. Old flocks should be separated from young birds by a distance of at least 200 yards. Flock segregation is of paramount importance in carrying out a program of disease prevention or control.

2. Locate buildings so that drainage water, which may be contaminated, does not flow from old to young stock. Do not place your buildings or range in a direct line of drainage from neighboring farms.

3. Arrange houses so that airborne infections will not be blown from old hens to young stock. For your own comfort, be sure prevailing winds will not blow from the poultry buildings to your home.

4. Place nesting facilities close together and as near the central egg storage room as possible. Egg collection is carried out three or more times a day. The shorter the distance from nests to egg room and cooler, the less time consuming the chore becomes.

5. Egg storage rooms are best located on the north or east sides of the buildings. Southern exposure will reduce the efficiency and increase the cost of egg room refrigeration. These rooms should be readily accessible to pick-up trucks.

6. Build a centrally located feed room that may be reached easily by feed trucks and carriers. If conditions permit, provide separate feed bins, tanks, or feed rooms for young and old stock.

7. Keep your culled birds as far from the rest of the flock as possible. Do not permit poultry dealers to bring their trucks close to laying or growing pens.

8. Provide plenty of room to house baby chicks, broilers, pullets, and hens. Overcrowded, damp pens are conducive to the growth and spread of infectious bacteria, viruses, and parasites. Birds that must fight their way to the feed hoppers or water fountains are not going to show maximum weight gains or top egg-production records. Also, crowded nests and dirty floors mean added hours must be spent scraping and washing eggs. No advantage is gained by crowding birds into their quarters. They deserve and need plenty of breathing, feeding, and leg room. (*See Chart 2.*)

BROODING, GROWING, AND LAYING UNITS

Brooding units are designed to house chicks from one day of age until they no longer need supplementary heat. *Growing pens* are used from the end of the brooding period until the broilers are sold or the pullets moved into permanent laying houses. *Laying pens or cages* are used for pullets and hens from the time they start to lay until they are culled and sold at the end of the laying period. *The Colony Brooder* is a portable unit using electric or infra-red lamps or a coal, gas, or wood burning stove as a source of heat. The brooder may be built on 4″ x 7″ braced runners to make it easier to move. A house measuring 12′ x 12′ or 10′ x 14′ (144 square feet total) will hold 250 to 300 chicks to 8 weeks of age. It will house 125 to 150

pullets or cockerels from 6 to 12 weeks of age; 50 to 75 pullets to 16 weeks; or 35 to 40 mature pullets, hens, or cockerels. The portable brooder house is ideal for raising birds on range. At the start of the season when the chicks are in need of supplementary brooding heat and constant attention, the houses are grouped closely together to minimize chore time. At the end of a 6 or 8-week period, heating systems are discontinued and the brooders are hooked onto tractors and moved to open range. They are then spaced approximately 150 feet apart. Range shelters should be provided as additional housing at this time. (*See Plate 1.*)

CHART 2

RECOMMENDED FLOOR SPACE ALLOWANCES

Age in Weeks	*Floor Rearing*	*Battery Rearing*	*Sunshine Brooder and Laying Cages*
1 to 3	6 to 7 square inches per chick	10 square inches per chick	100 to 125 chicks in 4' x 4' unit
3 to 6	Same as above	18 to 25 square inches per chick	Same as above
6 to 8	Same as above	30 square inches per chick	Same as above
8 to 10	1 square foot per chick. Remove cockerels	30 to 40 square inches per chick	25 pullets in 2' x 4' growing cage
10 to 12	Same as above	50 to 60 square inches per chick	10 to 12 pullets in 2' x 4' growing cage
12 to 16	1½ to 2 square feet per chick	Same as above	8 to 10 pullets in 2' x 4' growing cage
*16 to 20 and over	3 square feet, Leghorns; 4 square feet, heavy breeds	60 to 75 square inches per bird	Remove to individual laying cages or wire bottom pens

* *Note:* Where wide houses (measuring more than 24' x 24') and center island roosts are used, floor space requirements may be reduced to 2 or 2½ square feet for Leghorns and 3 or 3½ square feet for heavy breed hens. Experiments at Pennsylvania State College indicate that layers may do well with as little as 1 or 2 square feet per bird in wide houses using controlled ventilation, "thermopane" windows, and mechanical pit cleaners.

The permanent or long brooder house is suitable for intensive broiler production, winter brooding, and the confinement rearing of replacement stock when range facilities are not available. The permanent brooder may be used also to start early pullets that are to be put on range as the brooding season progresses. Runs, porches, or exercise yards are not recommended for use with permanent brooders. (*See also Page 45.*) One suitable design for a permanent brooder house calls for the construction of two pens measuring 20' x 20'. Allowing 1 square foot of floor space per broiler or re-

placement pullet, 1600 day-old chicks could be started in each pen. Three such houses would allow you to raise four successive broods of approximately 10,000 broilers for a total yearly output of 40,000 birds. A 20′ x 40′ center room is used for a hot air or hot water central heating system and for the storage of feed and equipment. Labor is minimized in houses of this size, especially if mechanical feeders and automatic water fountains are used.

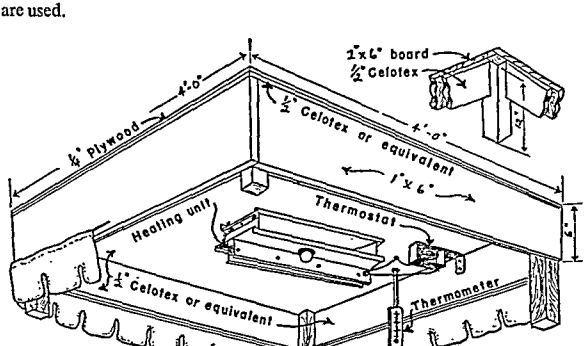

Fig. 2. An electric brooder that may be constructed on the farm. The unit may be used in sunshine or outdoor brooders. Cloth or canvas canopies with the bottom edge cut will enable chicks to pass in and out of the brooder easily. (Courtesy of the U.S. Dept. of Agriculture.)

Sunshine or Outdoor Brooders. Popular in sections of the country having temperate climates, outdoor brooders are used extensively in the west and southwest in conjunction with individual laying cages and wire-bottom pens. The brooder consists of a 4′ x 4′ hover heated by gas or electricity. If 10 square inches are allowed for each chick, the outdoor brooder will hold approximately 125 chicks. A 3′ x 6′ wire runway is attached to the hover and is separated from it by a canvas curtain.

Range Shelters. These shelters are designed primarily to house young birds from the end of the brooding period until they are ready to be moved to laying houses. The range shelter may be used as supplementary housing for the hens during the spring, summer, and early fall months. The 10′ x 10′ shelter shown in Plate 1 will hold 100 pullets until they are ready to be moved to laying pens. All range housing should be light in construction to permit periodic moves to fresh sections of range. As the pullets approach maturity, nests may be strapped outside the shelters for their use. This

practice will reduce the number of eggs laid on the floor when the pullets are placed in their permanent quarters.

Growing Cages. Indicated when outdoor brooders and wire-bottom laying cages or pens are used, growing cage units usually measure 2′ x 4′ and hold 8 to 12 pullets from their sixth through their twentieth week. As the birds get ready to lay, the number should be kept down to eight or ten birds (and no more) per cage. (*See Plate 2.*)

Housing. For laying flocks housing will vary according to the size of the enterprise, the climate, and the individual likes and dislikes of the poultryman. Multiple-story houses are common in the New England states. Straw-loft houses are popular in the Midwest. (*See Plate 3.*) Poultry farmers in some southern and western states prefer raising birds in individual wire cages or wire-bottom pens with only a roof and windbreaks for protection against the elements. Chicken houses may be, and sometimes are, little more than make-shift lean-to's, or they may be spacious buildings with all the latest features of modern agricultural engineering. For specific information about laying-house construction, the reader is urged to contact extension personnel at his state college or call on his county agent or nearest farm advisor. These people may offer specific recommendations and help furnish plans for the types of housing best suited to local conditions.

CAGE SYSTEM OF MANAGEMENT

Raising layers in wire cages is practiced extensively in southern California and in some sections of the Southwest. Some poultrymen in southern and northeastern states are using the cage system of management with certain modifications and have reported favorable results. The cage dimensions vary in width from 8 to 12 inches. Height and length measurements are usually 18 inches. A cage that is 8 or 9 inches wide is big enough for one Leghorn hen. Heavy breeds do best in cages that are at least 10 inches wide. If two birds are to be kept in one cage, a width of 12 to 14 inches is needed. The major advantages and disadvantages of the individual cage type of operation are as follows:

Advantages:

1. Culling guesswork is eliminated. And efficient culling means increased egg profits. Culls and poor layers may be spotted easily by checking daily egg records. Floor culling, on the other hand, entails the laborious task of catching or crating the birds or handling them on the roosts at night. With new pullets coming in to lay each week (with a multiple system of brooding), there is no room for the lazy or marginal producer. A high percentage of the flock will consist of young birds in production with only the exceptional hen being kept for a second year. Cage plant owners who consistently report high egg totals maintain 65 to 70 per cent production at all times. That is, 65 to 70 eggs are gathered each day for every 100 hens in production.

2. Labor-saving equipment, such as mechanical feeders, automatic water fountains, and motor-driven egg and feed carts lend themselves to cage operations and assure peak labor efficiency.

3. Mortality figures are comparatively low in cage operations. Roundworms, coccidiosis, and other filth-borne infections are virtually eliminated. Sick birds stop laying and are usually removed as culls before they succumb to the illness or can spread it to other birds (the notable exception being respiratory ailments). Weak birds have a chance to thrive when they are able to eat and drink freely without interference from other birds.

4. The cage system lends itself to year-round brooding, which permits a more efficient use of housing and equipment. Brooding costs are evenly distributed throughout the year; production cycles tend to even out; and greater egg production on less feed is accomplished by maintaining a high percentage of pullets. (A pullet needs less feed than a second year hen to produce a dozen eggs.)

Disadvantages:

1. Installation costs are high. Cages cost approximately $1 to $1.20 more per bird than a floor system of equal capacity.

2. Daily routine checking of birds, their feed troughs, and water fountains is of extreme importance in caring for caged layers. It takes a great deal of time to run a cage operation efficiently.

3. A high percentage of the eggs collected may be dirty, cracked, or dusty. (Periodic brushing of the wire trays that hold the eggs is helpful.)

4. Losses from respiratory infections occasionally may be high. The security that cage plant managers feel because their birds are kept off disease-ridden floors is often shaken by an outbreak of coryza, Newcastle disease, bronchitis, or chronic respiratory disease. Infections of the respiratory tract may spread rapidly through the closely grouped cages. Birds in cages are as susceptible as birds kept on the floor to mite infestations, pullet disease, range paralysis and big liver disease, and other common poultry ailments.

5. Birds in wire cages suffer more from the heat than birds on the floor. Losses from heat prostration occasionally may be high. They can be checked through the use of roof sprinklers or "fogging" systems.

6. Flies pose a perpetual problem for the cage plant operator. There is no litter to help drain off the moisture from droppings and leaks from water fountains. (*Methods of combatting flies are discussed on Page 130.*)

7. Inclement weather is a major concern to the cage owner. Water pipes must be protected against freezing in the winter and against overheating during the summer. Windbreaks must be constructed to act as a buffer against cold winds; sprinklers and foggers are needed to cool cages when temperatures rise above 90 degrees. Wire cages or wire-bottom pens usually are not recommended for use in areas that are subject to wide variations in temperature.

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CONSTRUCTION CONSIDERATIONS

The building of a new poultry house or the remodeling of an old one will present many problems in design and construction. Before you set out to buy materials or sign a contract with a builder, take time out to consult the housing and engineering experts at your state college of agriculture. These men will give you up-to-date information about developments in design and materials and will suggest plans for the types of poultry construction that will be practical under your farm conditions. In the following paragraphs are outlined a few construction suggestions. You are urged to fill in the details by writing the Agricultural Extension Service at your state college (*addresses listed on Page 229*) and by contacting the county agent or farm advisor in your area.

Conserving Space. Wide-pen poultry houses using center island roosts make it possible to house more birds on less floor space. Construction costs, on the basis of the number of birds housed, are lower. Flocks kept in wide pens take up less chore time than an equal number of birds separated into smaller units. But a word of warning if you are planning to build a wide-pen poultry house. Don't build it *so* wide that day-to-day handling of the flock becomes a near-forgotten task. You cannot walk into a room with 1,000 or more hens crowding around your feet and expect to detect all the culls, weak sisters, and sick birds. Periodic handling or culling of the flock becomes a near impossibility. The out-and-out culls may be found easily. But the poor producers and marginal birds require a closer examination than that performed with a flashlight or the random sweep of a culling hook in a crowded pen.

There are several other drawbacks to the too-wide pen. If the birds are overcrowded, they become frightened easily and may be stampeded into fatal pile-ups. They are more prone to cannibalistic outbreaks than birds confined into smaller numbers. Unless an adequate system of ventilation is installed, you may have trouble with dead air pockets, excessive condensation, and damp litter and floors. Finally, if an infectious disease should break out in the wide pen, quarantine measures would be practically impossible to carry out. Small pens lend themselves to effective control, treatment, and prevention of the common poultry diseases. When planning buildings, remember that pens should be large enough to minimize labor, *yet small enough to permit careful and continuous handling of the flock.*

Floors and Foundations. Concrete construction should be used wherever possible. Concrete offers a relatively impervious surface that permits easy scraping, sweeping, and washing or steam sanitizing. Concrete is virtually rat proof, in marked contrast to both dirt and wood surfaces. Warping or rotting of wood floors produces cracks and crevices that cannot be cleaned properly and that constitute natural reservoirs of infection for susceptible birds.

When wood floors *are* used, they should be of tight fitting shiplap or

matched lumber. Wood should be treated with a suitable mite repellent and preservative, such as carbolineum. One thickness of lumber may be adequate, but a two-board floor, the layers separated by a single thickness of building paper, is recommended in the northern states. Wooden built floors at least 10 inches off the ground assure maximum air circulation. Do not use, under any condition, warped or damaged lumber for flooring.

Sand and dirt floors are used for broiler and egg farms in some southern and western states. If either sand or dirt is used, at least 2 inches of the top layer should be removed and replaced with clean fill between broods.

A satisfactory concrete "formula" may be made by mixing *1 part cement, 2 parts sharp sand,* and *3 parts gravel.* Pour at least 2 inches of this mixture. Finish the floor by pouring 1 inch of the following mixture: *1 part cement, 2 parts sharp sand,* and *2 parts gravel.* A smooth surface will result from trowelling lightly with wood and finishing with a steel trowel. A single coat of water glass (*sodium silicate*) may be applied while the top layer of concrete is still wet and in the process of setting. Two pounds of calcium chloride added to each bag of cement will help the setting process and is especially helpful in preventing the concrete from freezing when the pouring is done in wintertime.

Pouring concrete floors on a 6-inch bed of cinders, broken stone, or flat tile seconds will tend to keep the floors dry during wet and cold months by breaking up the capillary action of water. It is particularly indicated for poorly drained soils. One thickness of tar paper, lapped and tarred at the seams and placed over the cinder bed before the first layer of concrete is poured, will help keep the floors dry.

Wooden floors may be surfaced with concrete. Clean and level the floor first. Then pour at least 1 inch of a mixture consisting of *1 part cement, 2 parts sharp sand, and 2 parts gravel* and spread evenly over the floor.

Provide for drainage at the time the concrete floors are made. Plan to have 1 inch of pitch for every 6 feet of floor space. Allow for adequate drainage to carry off spillage under each water fountain.

Walls. Poultry house walls may be constructed of a variety of materials. These include concrete, tile, matched lumber, wood lath, chicken wire, muslin, corrugated aluminum sheeting, plywood, or insulation board. Matched lumber is the most common and is usually 6 to 8 inches in width and ⅞ inch thick. One thickness will suffice in warm climates. It is advisable in colder climates to use a double thickness of matched lumber separated by one layer of roofing paper. The double thickness is recommended particularly for the back wall and the ceiling immediately over the roosting area.

Electricity. Over-all management efficiency is necessary in the brooder, growing, and laying houses. And many labor-saving devices, such as mechanical feeders, egg graders, and washing machines, rely on electricity. Electric power is used to operate resistance or radiant heaters and infra-red

brooders. Electric heating units are used to keep water supplies from freezing during the winter months. One of the most important functions of electricity is the lighting of laying houses to stimulate egg production during the short fall and winter days. A discussion of lighting for egg production is found on Page 77.

Proper Ventilation. Warm, moist, and stale air should be continuously replaced by cool, dry, and fresh air *in the absence of drafts.* One hundred hens in the course of a day's activity will give off 5 gallons of water through their breath and droppings. This moisture must be removed if pens and litter are to be kept dry. Ventilation may be achieved through the use of open windows, flues, ventilator boards placed under the eaves at the rear of the house, and mechanical aids, such as blower or suction fans. Ventilation cycles cannot be maintained if pens are crowded beyond their normal capacity. Leaks or cracks in the walls or ceiling also reduce the efficiency of ventilating systems. When there are not enough flues, the warm, moist air comes in contact with the cold surface of a wall or ceiling and water droplets are formed. The quarters become damp and unsanitary. Damp houses invite outbreaks of disease and internal parasites. Flues must extend 2 feet or more above the top of the roof and should be at least 18 inches in diameter. Weather caps will prevent rain and snow from entering the pen through open flues. Sliding or hinged doors installed at the top of the flues make it possible to adjust draft openings to meet varying weather conditions.

Insulation. An important adjunct to proper ventilation, insulation may consist of no more than a double wall separated by a sheet of roofing paper, or a 4 to 6-inch space filled with rock wool or wood shavings. Roofs constructed of aluminum sheeting or painted over with aluminum paint reduce temperatures during the summer by as much as 15 degrees. The extent and type of insulation you should have will be determined primarily by the weather conditions that exist in your area.

Birds housed in well-ventilated and well-insulated rooms do not consume as much feed in cold weather as birds kept in damp or chilly houses. In summer, a cool house helps stimulate appetites and maintain feed consumption so that egg production will not drop. Insulation and ventilation are two housing factors that must not be overlooked if maximum efficiency and maximum profits are to be realized.

Windows. Allow a minimum of 1 square foot of window space for every 20 birds housed. Wherever possible, cover windows with muslin or glass substitutes that will allow the entry of ultra-violet rays. The lower edges of windows should be no less than 3 feet above the floor to prevent harmful floor drafts. Other openings may be included in addition to window space. In the southern states as much as three-quarters of the house front may be exposed. Northern poultry houses usually are limited to a one-third opening for windows or shutters. It is suggested that windows and other openings be equipped

with protective shields or awnings extending 1 or 2 feet from the outside wall. These will prevent rain or snow from entering open windows.

Remember that cold air without direct drafts will not harm your flocks. Get them used to low temperature ranges by increasing window openings gradually during cold weather spells.

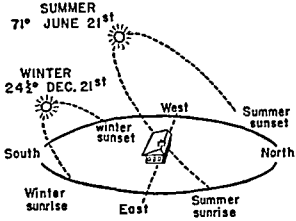

Fig. 3. Bring in more winter sun. Harnessing the warm rays of the sun will help reduce fuel and feed costs during the winter months. Large windows with a southern exposure will permit the entry of the slanting rays of the sun. (Courtesy of the Libbey-Owens-Ford Glass Company.)

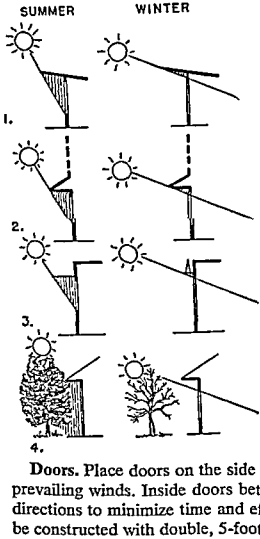

Fig. 4. Keep out summer sun. A roof overhang *and other devices may be used to advantage to* shade out the morning and afternoon rays of the high summer sun. The shading device does not prevent the winter sun from streaming through the entire winter area (right). 1) Roof overhang: simply an extension of the roof, whether it be gable or shed type. 2) Built-on sun shade: in the case of a two-story building, the windows on the *upper level can be shaded by a roof overhang,* but it will be necessary to build a shading device above the windows on the ground floor. This can also be done in cases of remodeling where the roof does not project enough to shade the windows. 3) Folding sun shade: the shading device can be designed to fold up and back in winter to let the sun come in, and dropped down in the summer to shade the window. 4) Trees: leaves provide shade for summer. Bare trees let the winter sun come in. Thus nature provides shade only when you need it. However, care must be taken that sufficient large trees are provided. (Courtesy of the Libbey-Owens-Ford Glass Company.)

Doors. Place doors on the side of the house opposite the direction of the prevailing winds. Inside doors between pens may be built to swing in both directions to minimize time and effort during chore time. Wide houses may be constructed with double, 5-foot doors to allow a truck or tractor to enter the house for pen clean-ups.

Roosts. Build roosts over dropping boards or pits in the rear of the pen. Center island roosts are desirable when pens are 24 feet or more in width. They are not recommended for flocks of less than 1,000 birds. When wide pens and center island roosts are used, floor space per Leghorn hen may be 2 to 2 and one-half square feet per bird. Heavy breeds need a minimum of 3 square feet per bird. The greatest advantage to centrally located roosts is the economy of floor space gained by having feed and water facilities directly on the roosts. With this arrangement, the birds spend about two-thirds of their time on the roost and most of their droppings fall out of reach beneath the roosts. The litter, nests, and eggs stay cleaner, and there is less contamination of feed and water. Moreover, birds using center island roosts appear to be less flighty than birds using conventional roosts. Multiple tier roosts have also been used by some farmers with a moderate degree of success.

When center island roosts are used, feed hoppers are placed on either side of the roost 18 to 24 inches from the outer edges. A passageway is left on all sides of the roost. Two inches of a suitable litter is scattered on the floor under the roost to form an absorbent base for droppings and water spillage. The pit is cleaned three or four times a year, or more often if conditions warrant. If mechanical pit cleaners are used, the droppings should be removed at least once or twice a week. This practice will mean dryer quarters, an increase in the number of clean eggs gathered, and a decrease in poultry disease and parasite losses.

RECOMMENDATIONS FOR CONSTRUCTION OF A CENTER ISLAND ROOST AND PIT

Dimensions:	*Length:* Sections 10 feet long for easy dismantling.
	Height: Never less than 12 inches. 24 inches preferred.
	Width: Center island roosts should be at least 12 feet wide. Leave a 5-foot alley on all sides.
Materials:	*Roost bars:* 2″ × 2″, 1″ × 2″, or 1″ × 1″ lumber. Round off all edges. Space bars 15 to 18 inches apart. Place first and last bars 8 to 10 inches from edge of roost. Paint wood with carbolineum or other suitable wood preservative.
	Netting: Roost top covered with 1½ inch, 16-gauge wire mesh; or 1 × 2 inch, 14-gauge welded wire. Roost front covered with 1-inch wire mesh.
Space Allowances:	*Birds one to six weeks old:* 3 inches per chick.
	Six to twelve weeks: 6 inches per bird.
	Twelve weeks and over: 8 to 10 inches per bird for heavy breed. Six inches per bird for Leghorns.

If dropping boards are used, build them at least 36 inches above the floor; allow a minimum width of 5 feet and use tight fitting tongue and groove lumber. Place the roosts 8 inches above the dropping boards. Be sure the front and tops of roosts are adequately screened.

PART II

BROODING AND REARING MANAGEMENT

Chapter 4

SELECTING YOUR STOCK

A BROODING AND REARING SCHEDULE SHOULD be planned and organized months before you purchase the first chick or order your first sack of feed. There are numerous problems to be solved and questions to be answered. Should you start with day-old or "started" stock? What breed or strain of bird is best? Are there chicks available from a source operating under the National Poultry Improvement Plan or can you rely on other, non-participating hatcheries or breeding farms? What are the advantages of raising sexed chicks (*pullets only*) over straight-run broods (*pullets and cockerels*)? How many chicks will you have to start to replace flock losses and operate at full capacity? What is the best time of year to brood? Your decisions must be made well in advance of the brooding season.

Breed. Choosing a breed for your broiler or egg farm, you may be influenced by market considerations as well as by personal choice. For example, there is a preference in most areas for white eggs over brown eggs, the New England states being the notable exception. Housewives' preferences defy analysis by marketing experts. Grade A brown eggs are exactly the same as Grade A white eggs in flavor, freshness, interior quality, and nutritional value. But, if you contemplate selling to other than the New England market, you should probably select a breed that produces white eggs.

The Single Comb White Leghorn. This fowl is by far the most popular of the white egg breeds. (Other white egg producers—Ancona, Minorca, Blue Andalusian, Buttercup, and Spanish breeds—are of no commercial importance in the United States.)

The Leghorns mature rapidly, attaining maximum growth and laying their first eggs at four and one-half to five months of age. The light, small-framed Leghorn is considered one of the most efficient converters of feed into a salable farm product. Leghorns show little or no broodiness. (Broodiness

results in wasted feed and a decrease in total egg production.) They are fast molting birds, and they require a minimum amount of time to shed their feathers and resume laying.

On the debit side, we find that Leghorns have relatively little value as culls when sold at the end of their laying days. Some farmers also object to the breed's tendency to be flighty and high strung.

Heavy Breeds. *The Rhode Island Red, New Hampshire, White Plymouth Rock, Barred Plymouth Rock* and other heavy breeds lay brown eggs. If derived from high-production stock, "heavies" are capable of matching the egg-production records set by many Leghorn strains. Heavy hens command top prices when sold at the end of their productive cycles. The extra weight (up to 6 pounds) and yellow skins make a more desirable market product. Their egg-producing qualities and value as cull birds have helped establish the heavy breeds as ideal dual-purpose birds. They are popular for use in farm-sized flocks. They are used extensively, along with their hybrid crosses, by broiler producers. Broiler chicks, to be profitable, must demonstrate quick growth and be able to attain market weights with a relatively low consumption of feed (3 pounds of feed for every pound of weight gained). They must also be rapid feathering—light feathers preferred—and demonstrate plump breasts and short, heavily muscled legs.

There are some drawbacks to stocking a commercial egg farm with heavy breeds. Outside the New England area, brown eggs are usually worth less on the market than white eggs of comparable quality. Because of their extra weight and a relatively slow rate of sexual development (maturity at about 6 months of age) the heavy birds require more feed than Leghorns to produce an equivalent number of eggs. They are slow molters and are inclined to broodiness—both factors contributing to lowered egg production and increased feed consumption. More floor space and additional feed hoppers, water fountains, roosts, and other equipment are needed to care for the larger birds.

SOURCES OF REPLACEMENT STOCK

Eighty-five per cent of the chicks started in this country are purchased from commercial hatcheries and breeding farms. These enterprises are operated by men who specialize in the production of day-old chicks. With the help of modern equipment, better training, and a greater volume of sales, the chicks can be turned out cheaper than, and superior to, the farmer's own efforts.

Breeding Farms. An important source of high-producing, progeny-tested stock is the breeding farm. Chicks purchased from these farms are usually the offspring of carefully selected, pedigree matings. Chance plays a relatively minor role in the geneticist's selection of breeding hens and cockerels. An animal chosen for breeding must be a healthy specimen with a natural resistance to disease. She must have a record of high egg production. The hen's breeding background is then appraised. What production

qualities were displayed by her parents, her sisters, and her brothers? Is this hen a high producer from only an average family, or is quality a rule rather than the family exception?

The next hurdle the bird faces is the *progeny test.* It is not enough to come from proved parents and to demonstrate individual production qualities. The superior bird must be capable of transmitting these qualities to its offspring. The testing of the daughters and sons of breeding hens and cocks (*progeny testing*) is one of the most effective screening methods in use. The painstaking work of the specialized breeder farms is responsible for producing chicks that are bred for fast growth, resistance to disease, and an inherent ability to lay 200 eggs or more a year.

Recurrent, reciprocal selection is a breeding technique recently adopted by some of the country's leading poultry geneticists. Simply stated, the method calls for the mating of pure strain birds on the basis of their ability to produce offspring that will be *superior* to either of the parents.

Commercial Hatcheries. Such businesses depend on outside supply flocks for most, if not all, of their hatching eggs. Because of the expense involved and the additional facilities needed for trap-nest, pedigree, and progeny work, most hatcheries cannot afford to make full use of all breed-improvement methods.

The progressive hatcheryman, however, carefully examines and selects birds that meet high physical and egg-production standards. If possible, the hatcheryman arranges to use males with proven progeny and pedigree records or cockerels whose full sisters have made outstanding production records. The man interested in quality as well as quantity does not set eggs weighing less than 23 ounces to the dozen. He insists on selecting eggs that are uniform in size, shape, color, shell texture, and interior quality. No conscientious hatchery manager will use eggs from supply flocks that have not been tested and declared free of pullorum disease.

Whatever the source of your chick supply, the proof of the product is measured not in terms of fancy advertisements and glowing testimonials, but in terms of your own success in nurturing these chicks into profitable broilers or replacement pullets. Here are the standards to consider when selecting breeding stock:

Physical appearance: Birds have constitutional vigor and no serious defects or blemishes. They meet standard weights for the breed.

Number of eggs laid: Egg production should average 15 to 20 eggs per month, or a total of 200 eggs or more in 365 days. Production is estimated by pigmentation or trap-nest records. (*See Page 103.*)

Ability to maintain production: The birds are able to lay without broody periods or a late fall or winter pause. Late season molts are of short duration. Birds lay 12 months or longer and resume production in 2 to 3 weeks after molting.

Average size of eggs: Pullet eggs weigh 22 to 24 ounces per dozen when the birds are 7 to 9 months of age. Eggs saved for hatching average 23 to 24 ounces per dozen.

Color, shape, texture of eggs: Eggs are uniform in color. No tinted eggs from white egg breeds. Hens laying eggs that are low in interior quality or that have poor shells are eliminated as breeders.

Maturity: Leghorn pullets weigh 3 and one-half pounds and lay their first egg at 4 and one-half months (150 days). Heavy breeds weigh 3 pounds and lay their first egg at 5 and one-half months (170 days).

Ability to resist disease: Birds must sustain high egg production and show a low rate of mortality. Natural resistance to range paralysis, big liver disease, and other forms of the avian leucosis complex is very important. Hens and cocks should be blood tested to make sure they are free of pullorum infection.

Family records: Pedigree records should indicate high-producing ancestors. There must be some indication of family purity based on performance records of sisters and brothers.

Progeny: Ultimate tests of breeding quality are satisfied if the offspring perform as well or better than their parents.

Many of the country's leading breeders, in order to compare results and publicize their stock, submit representative samplings to Egg Laying Contests or Random Sample Tests. These tests are under the official supervision of agricultural colleges from many states, including New York, New Jersey, Connecticut, Massachusetts, and California. Monthly progress reports appear in farm magazines, newspapers, and poultry periodicals. These reports provide valuable information about the different strains, such as age of sexual maturity, number and weight of eggs produced, the percentage of mortality within the pen, the number of pounds of feed required to produce a dozen eggs or a pound of meat, and the approximate income over feed and chick costs of each contesting pen. The information contained in these reports may serve as a useful guide in choosing the source of your replacement stock.

PURCHASING PULLORUM-FREE BIRDS

Pullorum disease was once regarded as one of the most deadly diseases of young and adult fowl. Farmers could not start chicks without the constant fear that their broods might succumb to this highly fatal blood infection. Today you can purchase chicks from breeding flocks that are blood tested and designated as "pullorum clean" or "pullorum passed." Hens and cocks free of pullorum infection will produce healthy offspring. (*See Plate 4.*)

Pullorum disease control work is usually carried out by state agricultural or veterinary officials working under the provisions of the *National Poultry*

Improvement Plan. Farmers should acquaint themselves with the purpose and content of this plan, which

. . . has been developed with a view to the establishment of the poultry breeding industry on as sound a basis as possible. The plan affords protection from unscrupulous competition and enables purchasers to buy with more confidence. The adoption of the plan in all parts of the United States should bring about an improvement in the quality of hatching eggs, baby chicks, breeding stock, and market products. Such results should cause poultry production to be more efficient and thus aid in making the poultry enterprise more profitable.

The objectives of the National Poultry Improvement Plan are to improve the breeding and production qualities of poultry, and to reduce losses from pullorum disease. This is being accomplished by 1) the development of more effective State poultry improvement programs; 2) the identification of the quality of breeding stock, hatching eggs, and chicks by authorized terms that are uniform and applicable in all parts of the country; and 3) the establishment of an effective cooperative program through which newer knowledge and practical experience can be applied to the improvement of poultry and poultry products.

Acceptance of the National Poultry Improvement Plan is optional with States and individual members of the industry within the States. The plan is administered by official agencies in cooperation with the Agricultural Research Service, United States Department of Agriculture.

A list of official agencies and a more detailed description of the plan may be obtained by writing to the Office of Information, United States Department of Agriculture, Washington 25, D.C. Ask for Miscellaneous Publication Number 300.

Breed Improvement Phase of the N.P.I.P.: There are four breed-improvement plans in which breeders, hatcheries, and supply flock owners may participate. They are U.S. Approved, U.S. Certified, U.S. Record of Performance (ROP), and U.S. Register of Merit (ROM). As the poultryman progresses from one plan to another, the requirements become more exacting. Unless special provisions are made, those qualifying for the various breeding stages must also participate in the official pullorum eradication program.

U.S. Approved Breeding Stage: To qualify for the beginning stage of the N.P.I.P., all potential breeding stock must be examined by an official agent of the local breed-improvement office. Hens and cocks qualifying for approved breeding flocks are picked on the basis of standard bred and production qualities. Approved hens and cockerels are identified by officially sealed and numbered leg bands. Eggs saved for hatching must average 23 to 24 ounces to the dozen.

U.S. Certified Breeding Stage: Certified breeding flocks are made up of U.S. Approved hens bred to pedigreed cockerels from U.S. Record of Performance, single male matings. Qualifying cockerels must meet standard weight requirements for their particular breed and must be free of any disqualifying defects.

U.S. Record of Performance Breeding Stage: R.O.P. selections are made on the basis of individual performance records. The candidate hens are

trap-nested for 365 days, during which time they must produce 200 or more eggs. The eggs are officially checked for weight, quality, and quantity. Three-hundred-day trap-nest records are also allowed, with the hens being required to produce 180 eggs or more. Record of Performance hens must be physically strong and have no disqualifying defects. Selected hens are bred to pedigreed cockerels from R.O.P. single male matings.

U.S. Register of Merit Breeding Stage: R.O.M. ratings are granted after a careful study of the performance records made by the sons and daughters of the candidate hen and cock birds. The true value of a breeder is determined not only by its own record, but by that of its progeny. To qualify for the Register of Merit, an R.O.P. cock bird must have one-half, or a minimum of 20, of his daughters qualified for R.O.P. ratings. An R.O.P. hen may be designated for the Register of Merit when one-half, or a minimum of four, of her daughters have qualified for the Record of Performance stage of the plan.

The Register of Merit breeding stage combines three important breed improvement measures: individual performance and appearance, ancestry (pedigree), and performance records of the offspring (progeny testing).

Many of the breeders and hatcherymen in the United States and Canada are in wholehearted support of the National Poultry Improvement Plan. There are others, however, who decline to participate. These men object to the supervision exercised over members and some oppose certain of the breed improvement methods advocated by administrators of the plan. It is not the author's intent to argue the pros and cons of the National Poultry Improvement Plan. We do recommend, if you are not thoroughly familiar with a breeding farm or commercial hatchery, or know the reputation of their products, that you let the N.P.I.P. labels act as your guide to the purchase of quality chicks.

Start with Quality Stock. Proper management brings out the best in a bird; it does not cover up her faults. Whether you are contemplating a broiler farm or an egg farm, plan to start with high-producing and fast-growing, quality birds. Experts working at universities, government testing stations, and private breeding farms have helped lift the poultry industry out of its "backyard flock" status. The hen laying more than 200 eggs a year is no longer a State Fair novelty. She is as common as her plodding, low-production cousins were 10 or 15 years ago. Two hundred or more eggs a year, or reaching market weight at 11 weeks, may be part of a bird's genetic makeup; but it still takes "the eye of the master" to help her realize this potential.

Cost of Quality Chicks. High-bred, disease-free chicks demand a high price. Is it worth your while to pay a premium for your chicks? Will you be getting dollar value for each dollar you spend? Many poultrymen, the author included, are convinced that top-priced, progeny-tested chicks represent a wise investment. This belief is supported by the results of studies

conducted by poultry economists throughout the country. Figure 5 graphically illustrates the difference between the high-producing and the run-of-the-mill pullet. The extra feed consumed by a 200 or 250-egg hen is paid off many times over by the "bonus" eggs produced at the end of the laying season. Seventy eggs a year will pay the feed bill for the average Leghorn hen. Eighty eggs a year will pay a heavy hen's annual feed bill. It is estimated that 150 eggs are needed to realize a profit from each bird after feed and other expenses have been met.

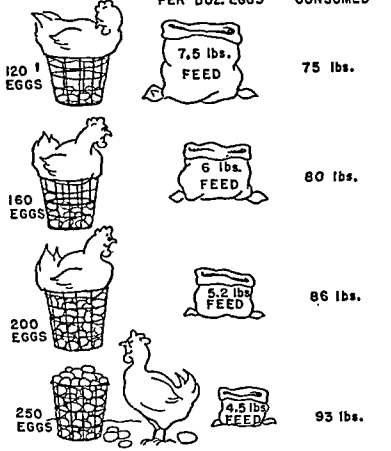

Fig. 5. Production bred, quality stock is a worthwhile investment. The true value of a bird is measured by the number of pounds of feed consumed per dozen eggs produced.

Day-Old or Started Chicks? Day-old chicks are recommended for establishing or replenishing your laying or broiler flocks. Chicks bought from a hatchery or breeding farm should be bright, alert, and free of diseases or parasites. Started chicks (birds that have been brooded for varying periods of time before their purchase) may be bought at 2 to 4 weeks of age or when they no longer require supplementary heat. Others are sometimes secured as "ready-to-lay" pullets. You may wish to buy started chicks if you haven't adequate brooding facilities, if you lack the time or the confidence in getting your chicks past the critical brooding stage, or if you do not want

to nurture them through their four to five-month growing period. Sometimes a poultryman, when faced with a shortage of replacement birds, will bring his laying pens up to capacity by purchasing ready-to-lay pullets.

The purchase of a 4 or 5-month-old pullet relieves you of the responsibilities and financial burdens of brooding and rearing. And the idea of getting an immediate return on your investment may seem attractive. The bright picture may be somewhat dimmed by these facts: Ready-to-lay pullets that have been raised on wire or in batteries will not adapt themselves to floor conditions. Started chicks may be carriers of bronchitis, coryza, chronic respiratory disease, and other ailments. Unfortunately, these birds may be capable of spreading a disease, and yet not always show active symptoms of the infection. It is important to make a careful investigation of your source of supply before buying started chicks or grown pullets. And, finally, buying outside stock is more expensive than raising your own replacement birds.

Sexed Pullets or Straight-Run Chicks? Sex differentiation in day-old chicks is made possible by a system known as Japanese sexing, a relatively harmless procedure when done by properly trained personnel. Highly skilled technicians examine the underside of the vent of newly hatched chicks. Close scrutiny reveals a small, slightly raised area, which is the nonfunctional remains of a penis in the male chick. Pullet chicks do not have this rudimentary swelling. The accuracy of a chick sexer's work is determined by the number of "slips" he makes, and the practiced man usually makes not more than a 2 per cent error. The price you pay for sexed pullets includes the cost of the discarded male chick plus a slight charge to help defray the cost of the sexing work. Thus, if straight-run broods (cockerels and pullets together) are quoted at 20 cents, your cost for sexed pullet chicks will be approximately 45 cents.

Sexed pullets seem to grow faster and more evenly than pullet chicks in straight-run broods. They reflect the benefits of the extra floor space and uncrowded feed and water facilities. Maximum use of housing units and equipment is possible when sexed pullets only are brooded. If the production of market eggs is your primary interest, it is best to start with all pullet broods.

Straight-run broods should be considered only if adequate brooding facilities are available for handling them properly. Move cockerels to separate quarters when they are 6 to 8 weeks old. They may be fattened and sold as broilers, fryers, capons, or chemically treated caponettes. (*See Page 58.*)

Is There a Best Time to Brood? Not very many years ago, farmers thought twice before brooding chicks at any time other than late winter and early spring. The months of January through May seemed best for producing chicks that would grow fast, mature rapidly, and produce a greater percentage of large eggs when egg prices were high. Early broods would produce their small and medium-sized eggs during the months when the differ-

ential between large and small eggs was at its lowest point. The seasonal brood also meant reduced fuel costs, avoidance of hot weather slumps (*the birds would not be in full production until the weather was cooler*), and full use of range, thus lowering feed bills.

Out-of-season chicks raised during the months of June through December would begin to lay when egg prices were low. They produced a greater number of small eggs and usually returned less profit than their spring-hatched cousins. These handicaps have now been largely offset through the development of new feeds and feeding methods, the use of lights in the laying pens to prevent early molting, and the breeding of chicks capable of full production regardless of the season.

Multiple brooding, or starting broods around the calendar, is a practical and profitable procedure. Brooding five and six times a year results in an over-all reduction of production costs. Housing, equipment, and labor are better utilized and their cost is spread evenly throughout the year. Seasonal peaks are avoided. A high percentage of pullets may be kept in production throughout the year. Cull hens are sold at intervals when meat prices are high, and the glutted live poultry market in the fall is avoided. A predominantly pullet flock will lay more eggs of higher quality on less feed than older birds. (A Leghorn's second year production is 87 per cent of its first year's record. Heavies will lay only 80 per cent of their first year's production.) And pullet flocks can sustain a high rate of egg production with comparatively little mortality.

How Many Chicks Should You Brood? The number of chicks you will need for pullet replacements will depend on the number of birds culled and lost during the growing and laying periods. The figures for Chart 3 assume that only 70 pullets out of every 100 sexed chicks started will reach the laying house. Thirty per cent will fall by the wayside because of disease, miscellaneous deaths, and a rigid culling program.

BETTER CHICKS DESERVE BETTER HOMES

Poultry houses must satisfy certain basic requirements, regardless of the brooding and rearing system used. They must be durable; they should be reasonable in cost; and they must provide an environment suitable for young and growing chicks. You should house young birds 200 or more feet from adult flocks, arrange houses to minimize labor, allow for future expansion, and see that houses face to the south or southeast to get maximum warmth during spring and winter months.

Crowded conditions encourage the outbreak and rapid spread of many diseases and vices. Start your broods with a minimum of 6 square inches per bird. A chick's weight will increase (along with its appetite) 12 times during the first six weeks of life. Be prepared to expand feeding and watering facilities as the season progresses. Don't try to stretch your luck by

CHART 3

Percentage of Hens Lost Through Death and Culling	*Pullet Replacements Needed Per 1000 Chicks*	*Number of Pullet Chicks to Start*
30	300	430
35	350	501
40	400	572
45	450	644
50	500	715
55	550	786
60	600	858
65	650	929
70	700	1,000
75	750	1,072
80	800	1,144
85	850	1,216
90	900	1,287
95	950	1,359
100	1,000	1,430
110	1,100	1,573
120	1,200	1,716

Note: When straight-run chicks are used, double the figures in the right hand column. Surplus pullets may be sold as meat birds or the best ones may be housed in temporary quarters and used to replace losses during the first few months of pullet production.

overloading the brooder houses or equipment. Adequate room will result in increased weight gains, improved feed efficiency (more weight on less feed), and a decreased incidence of disease and cannibalism.

In computing floor space and feed and water requirements, remember that cockerels should be separated from straight-run broods at 6 to 8 weeks of age. The remaining pullets will need at least 1 square foot of floor space. Don't start more than 250 to 300 chicks in a 12′ x 12′ brooder house. At six weeks, this area will safely hold no more than 125 birds. If you fail to thin out your brood at this time, nature may do the job for you in a far more devastating manner. It is advisable to raise only sexed pullets if brooding facilities are inadequate to care for both cockerels and pullets.

The use of sun porches, yards, or outdoor runs in conjunction with a semi-confinement system of management is generally not advisable. Chicks cannot use the runs in inclement weather and any advantages, such as savings in floor space or brooder capacity, are nullified on wet or cold days. Unsanitary runs may result in costly disease and parasite problems. A three-year land-rotation system is considered necessary to free the soil of harmful bacteria and parasite eggs. (*Range system of management is discussed on Page 52.*)

Let Equipment Work for You. Don't handicap your efforts with poor equipment. Select brooding tools that you can rely upon to give you the best results with a minimum of effort. Dependable equipment will pay dividends in time and labor saved.

Chapter 5

BROODING UNITS

THE PRODUCTION OF HEALTHY, WELL-DEVELOPED pullets or broilers starts in the brooder house. One of the most important pieces of poultry farm equipment is the brooding unit. A stove or hover must be chosen carefully to satisfy the particular needs of each farm.

There are many types, styles, and sizes of brooder stoves on the market that employ a variety of fuels. The equipment usually is rated by the manufacturer according to the number of chicks that may be started under each unit. When choosing your brooding unit, keep these considerations in mind: the size and condition of your brooder houses; the number of chicks that you will be starting at any one time; and the availability and cost of fuel in your community. Pick equipment that may be assembled, disassembled, and cleaned easily. If you are buying a coal or oil stove, select one with a sufficient fuel capacity to last through the coldest nights. Be sure to get equipment that is safe against carbon monoxide leaks, explosions, or outbreaks of fire. It is not necessary to order the most expensive brooding unit in the store; it *is* important to get a brooder that is safe, dependable, and suited to your production needs.

Electric Brooders. Heating elements, which may be thermostatically controlled, are surrounded by an insulated hover or guard in electric brooders. The unit usually contains high-resistance wire that supplies enough heat to warm the chicks under the hover. These brooders are satisfactory in areas where electric power is dependable and moderate in cost. They have a wide range of efficiency and may be used for broods with as few as 25 chicks or as many as 500. They have the advantage of warming the immediate brooding area without overheating the rest of the house. The unit is adjustable within a narrow temperature range. The thermostat controlling the heating elements is sensitive to a temperature range of 1 or 2 degrees. Electric brooders are relatively inexpensive to run. Operating costs may be reduced if a small canvas curtain is placed at the bottom of the hover and if the hover itself is well insulated. The brooders present little or no fire hazard because short circuiting is minimized by careful placing of fuses or

circuit breakers. The units are light in weight and may be dismantled, cleaned, and stored easily.

However, there are several drawbacks to electric brooding equipment. Because of the limited amount of heat they generate, electric brooders are not very satisfactory for cold weather, late winter brooding. They are not safe to use in areas where power failures are frequent. Damp litter is often a problem when electric brooders are used. The condition is helped if the litter is raked daily and if brooders with insulated hovers and built-in circulating fans are used. The cost of brooding with electricity is slightly higher than with coal, gas, oil, or wood.

Infra-red lamps have grown in popularity as a method of supplying brooding heat. The lamps transmit deeply penetrating heat rays that warm the chicks without heating the air between. A 250-watt bulb provides enough warmth for 100 chicks when built-in reflector bulbs are used. A set of five 75-watt lamps may be placed 18 inches to 24 inches from the floor. If more than one bank or battery of lamps is used, the units should be 10 feet apart. Each week the lights are raised 3 inches until the chicks no longer require heat. This is usually an 8 or 10-week period depending on seasonal variations in temperature and the amount of feathering on the birds.

Infra-red brooders are used without hovers and the growing chicks can be seen and checked easily by the caretaker. There is relatively even distribution of heat throughout the brooding area. Hot and cold spots that are conducive to chick crowding, costly pile-ups, and damp litter are avoided. Installation costs for infra-red lamps are moderate to low. Operational costs are comparatively high, but they may be reduced by using voltage regulators with either thermostatic or manual controls. If the lamps are used in large rooms, suction or blower type fans may be needed to provide sufficient ventilation. (*See Plate 5.*)

Radiant heat tubes in metal reflectors are available as another source of infra-red heat. The tubes vary from 300 to 1,500 watts in size and are set 18 inches above the floor for the entire brooding period. For best results with either type of infra-red heating, follow the manufacturer's directions carefully.

Coal Burning Brooders. This type of brooder, with a capacity for 200 to 400 chicks, is efficient and economical. There are many models and types on the market, but the basic design and method of operation is essentially the same. A fire box capable of holding about 50 pounds of coal is hooked up to a system of flues, vents, and thermostatically controlled dampers. The fire box is surrounded by a metal hover varying in diameter from 42 to 60 inches. The coal burning unit is one of the most economical from the standpoint of fuel costs, and the initial purchase price and installation cost are relatively low. The intense heat generated is ideal for late winter and early spring brooding, but not very practical for late spring and summer brooding.

A serious disadvantage of using coal brooders is the danger of fire caused

by mechanical failure or carelessness. Also, a leaky flue or clogged chimney may result in the loss of an entire brood from asphyxiation. Another drawback is the excessive amount of labor required for proper maintenance of the fires.

Wood Burning Brooders. Offering no advantages over coal burners and presenting the same disadvantages of greater labor and increased fire hazards, wood burning brooders are recommended only for small farms where the owner has access to cheap and plentiful wood supplies.

Gas Brooders. Both natural and manufactured gas brooders have gained widespread acceptance in many parts of the country. (*See Plate 6.*) They are inexpensive to install and are particularly valuable for spring and summer brooding. Because they generate a limited amount of heat, supplementary heating units may be needed in extremely cold weather.

Oil Brooders. Comparing favorably with gas and electric units with respect to operating costs, oil brooders can be utilized in both cold and warm weather. Oil burners provide a dependable, easily regulated source of heat. Extreme caution must be exercised in the operation of oil brooders to minimize the danger of fires. Fuel lines should be checked periodically and cleaned and adjusted according to the manufacturer's directions.

Permanent Brooder Installations. The use of hot water, hot air, or radiant heating systems should be considered if you are planning a flock of 5,000 or more birds. Commercial broiler men find a permanent heating system a *must* for efficient, low-cost production.

The expense of building a permanent brooding system has these compensations: lower fuel costs, a marked reduction in labor, a 25 to 40 per cent saving in housing and equipment depreciation, and the consistent brooding of well-fleshed and evenly feathered replacement pullets or broilers.

Hot Water Brooding Systems. These systems may be fired by gas, oil, or coal furnaces. Water heated in the central boiler is sent to each pen through a series of 6 to 12 pipes spaced about 4 inches apart. The pipes rest 10 to 15 inches above the floor and a 5-foot clearance is allowed from the edge of the hover to the back wall. The pipes usually are located near the center of the pen and extend to within a few feet of the end of the house. Plywood, building paper, sheet aluminum, or any other suitable material may be used for the hover. A layer of wood shavings scattered over the top of the hover will help confine the heat to the immediate brooding area. If the hovers are suspended on pulleys, they may be pulled out of the way when the chicks no longer need brooding heat.

The number, diameter, and placement of pipes will depend on the dimensions of the pens, the extent of insulation in the brooder house, and the climate. Fin-vulcan pipe 1 and one-half to 2 inches in diameter may be installed 1 foot above the floor with provisions made for a smooth pipe

return of hot water to the central boiler. A 4-inch-wide hinged skirt or hover may be suspended from the ceiling.

Another type of central heating forces hot air through pipes or ducts to the individual pens. Radiant heat installations utilize hot water passed through plastic or copper tubing that is buried under concrete floors.

Battery Brooders. These installations are made up of wire-bottomed compartments, each one containing an electrically heated unit. *Starting* and *growing batteries* are used extensively by commercial hatcherymen for housing surplus chicks until they may be sold. Although battery units are often used in garages, cellars, or storerooms, they give best results when arranged in specially designed brooding rooms. These rooms are built with particular attention paid to insulation, ventilation, and an auxiliary source of heat. A temperature of approximately 70 degrees must be maintained, and humidity and air circulation must be controlled carefully at all times. Proper adjustment of the brooder room conditions helps prevent outbreaks and spreading of respiratory ailments.

Battery Room Construction. Provide forced draft ventilation in summer and winter. Use suction or blower fans. Avoid direct drafts. Completely insulate walls and ceilings. Floors and walls of concrete and tile can be washed and disinfected easily and will provide a tight seal when fumigating is necessary. Have windows high and well spaced to provide adequate light. Allow a two-foot clearance from the top battery tier to the ceiling and a minimum head space of ten feet. Place batteries 15 inches apart and allow a 3-foot aisle between rows. Place the first tier 15 to 18 inches off the floor. Remember that the room temperature must be kept between 60 and 80 degrees at all times. Supplementary heat from space heaters, oil stoves, or radiators may be needed during the winter months.

Battery installations are suitable under the following conditions: 1) If a broiler market is close to your farm; 2) If you find it profitable to meet consumer demands with a different lot of birds each week; and 3) If high feed prices and expensive land prevent the building of a floor operation. Battery reared broilers reach market weight in less time and on less feed than birds raised on the floor.

A high initial investment is needed for battery equipment. The cost is considerably greater than when starting birds on the ground. Birds that are raised on wire must be slaughtered immediately after their removal from the cages or batteries. There will be excessive weight shrinkage if the birds are shipped to finishing or feeding stations prior to slaughter. The battery broilers are highly susceptible to bruising and their brittle bones tend to break with the slightest provocation. Battery operations occasionally suffer heavy losses when respiratory diseases strike the confined birds. The organisms causing these diseases spread rapidly through the crowded batteries. When more than one age group is kept in a single room, the problem is in-

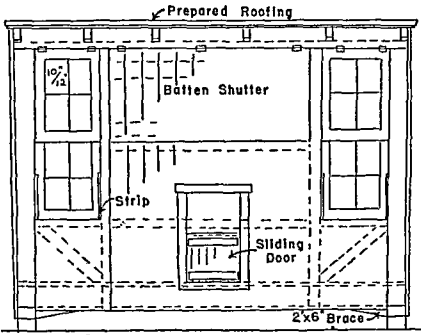

Fig. 6. Front elevation of colony brooder house. The heavy bracing shown above is required in a brooder house that is to be moved on runners. Batten shutters and windows may be covered with glass substitutes or unbleached muslin. When chicks are old enough to go outdoors, the sliding doors remain open during the day. They are closed when the chicks are bedded down for the night. (Courtesy of the United States Department of Agriculture.)

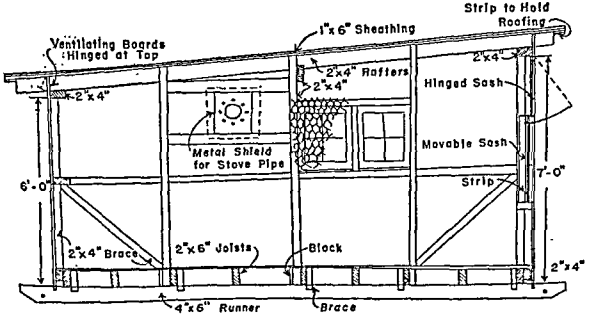

Fig. 7. Section of colony brooder house. The basic design shown above may be altered to fit your specific brooding needs. Ventilation is provided by openings on the sides and an adjustable board under the eaves. Lower sections are removable to supply extra ventilation for summer broods. Upper windows and shutters are hinged on top and *swing out. Lower sash and shutters* are covered with a glass substitute. This permits the entry of ultra violet rays of the sun, which are filtered by ordinary glass. (Courtesy of the United States Department of Agriculture.)

tensified. Birds raised on wire are prone to the development of breast blisters and crooked keel bones, conditions that seriously affect their market value. Contrary to popular belief, battery-reared flocks require more care than birds kept on the floor. The beginning poultryman is advised to use the floor system of management until he has had an opportunity to learn the pitfalls that may be encountered with the battery system.

Outdoor Brooders. Sometimes called *sunshine brooders,* they are used primarily on the west coast and in southern states in conjunction with *laying cage operations.* The wire-bottomed brooders may be heated by electric or gas units. They are designed to house up to 125 chicks. Birds are kept in these brooders with access to wire-bottomed outdoor runs until they no longer require heat. In warm climates, the cage plant managers usually are able to cut off heat when the chicks are five or six weeks old. At this time they are moved to 2′ x 4′ growing cages large enough to house 25 pullets to 10 weeks of age or 8 to 10 birds to maturity. Pullet replacements are selected from the growing pens to fill the laying cages vacated by culls or poor producers. The outdoor brooders have a limited capacity and are not practical when large broods must be reared at one time. They work best when a multiple brooding schedule and a continuous, high-percentage culling program are carried out. Chicks should not be started on wire-bottomed brooders or batteries if they are to be transferred to conventional floor pens at a later date. These birds will be highly susceptible to filth-borne diseases that may be encountered in floor operations. However, chicks started on the floor may be moved safely into wire cages as they approach maturity.

Furnishing the Brooder House. Heat alone does not make a brooder house. You must have an adequate supply of chick-size feed hoppers, an assortment of various sized water fountains (or provisions for an automatic watering system), wire covered platforms for water and feed utensils, additional hoppers for grit and grain, hover guards to keep chicks close to the source of heat, and roosts to be used when the chicks are four weeks old. There are many types of feed hoppers, water fountains, and other implements that may be purchased from your local feed store or hatchery. Wire platforms, roosts, and wooden feed hoppers may be made on the farm. All brooder house equipment should be simple yet durable in construction. Chicks do not appreciate fancy and impractical feed hoppers and water fountains. Their needs will be met by clean equipment, sanitary and dry surroundings, and a comfortable place to bed down for the night.

Prepare a Brooding Schedule. If your brooding schedule has been wisely arranged, you will have ordered your chicks, the best available, well in advance of delivery dates; you will have housing and equipment ready, and you will have arranged for delivery of a wholesome, well-balanced chick mash. The following timetable may be used as a reminder of chores that must be done *before* the chicks arrive.

BROODING TIMETABLE

3 to 4 weeks before chicks arrive	Clean, disinfect, repair, and thoroughly air and dry all brooder houses.
2 to 3 weeks before brooding starts	Apply carbolineum to roosts and other wooden construction in contact with the birds. Be sure heating system (stoves, hover, lamps, etc.) is tested and in working order.
2 weeks before brooding starts	Clean and disinfect feed hoppers, wire platforms, hover guards, roosts, and water fountains.
3 days before brooding starts	Have 2 to 4 inches of a clean, dry litter scattered on the floor.
2 days before brooding starts (continue for one week thereafter)	Turn heat on and bring hover temperatures up to 95 degrees. Record temperature 2 inches above floor near edge of hover and 2 to 3 inches outside the edge of gas brooder.
Day the chicks arrive	Provide night light (10 watt bulb or kerosene lamp) to prevent pile-ups. Continue throughout brooding.
Day the chicks arrive	Have chick mash in hoppers and scattered on egg case flats. Use flats for 3 or 4 days.
Day the chicks arrive	Place hover guard 18 inches from the hover to keep chicks near feed, water, and warmth. Widen circle each day and remove guard after one week.
Day the chicks arrive	Cover litter with paper sacks or plain paper to prevent litter eating. Discontinue after 3 or 4 days. Allow 6 square inches of floor space per chick.

When the Chicks Arrive. Arrange to have the chicks picked up at the Post Office, Railway Express Office, or airport just as soon as they arrive. Some hatcheries and breeding farms offer door-to-door delivery in specially designed trucks. State your preferred method of delivery when ordering the birds. Make sure enough holes have been punched in the chick boxes for proper ventilation. Be sure the chicks are protected against drafts, cold, or dampness. Distribute the chicks to their individual brooder houses or pens. The brooder house should be warm, the chick mash ready, and the chill taken out of the water in the fountains. Have the litter covered, and the hover guard fixed securely in place. (*See Plate 7.*) Carefully examine each chick. Destroy or segregate any runts or weak birds. Give the chicks a chance to get used to their new surroundings before leaving them to their own devices.

Chapter 6

MANAGING THE GROWING CHICK: THE FIRST EIGHT WEEKS

CHICKS MUST HAVE WARMTH FOR GROWTH, (a uniform source of heat) and not be exposed to sudden, extreme, or prolonged variations in temperature. Chicks will thrive in cool brooding rooms (65 to 70 degrees) as long as they are able to scramble back easily to the warmth of the hover. Most heating units are maintained at 95 degrees for the first week of brooding. The temperature is dropped 5 degrees each week until the chicks no longer need supplementary heat. The use of guards 12 to 15 inches high and 18 inches from the edge of the hover will keep the chicks confined to the source of heat. (*See Chart 4.*) Increase the diameter of the guard gradually, and remove it after five or six days when the chicks have learned to find their way back to the hover area.

When to discontinue heat. Artificial heat is supplied for 8 to 12 weeks for winter and early spring broods. Chicks hatched in the late spring and early summer may require heat for no more than six weeks. Heating units

CHART 4

RECOMMENDED BROODING TEMPERATURES

Age	*Hover Temperature (2" above litter)*	*Room Temperature*
1 week	*90°—95° F.*	*70°*
2 weeks	90°—95°	70°
3 weeks	90°—95°	70°
4 weeks	90°—95°	70°
5 weeks	75°—77°	65°
6 weeks	70°—72°	65°
7 weeks	65°—70°	60°—65°
8 to 12 weeks*		

* No heat necessary for late broods. Use stoves on cold nights and very cold days for early broods. Room temperature at 60° or less.

Note: Add 5 degrees to the above temperatures when using electric brooders. In areas where warmer climates prevail, temperatures may be reduced faster than indicated. Cooler temperatures usually encourage rapid and even feathering. Multiple deck, battery, and outdoor brooder temperatures may be reduced to 75 degrees in four or five weeks. Place chicks in growing batteries or cages at 5 to 8 weeks of age.

are usually cut 5 degrees each week until temperatures ranging from 65 to 70 degrees are reached and the chicks are well feathered and roosting comfortably. Regulation of brooder house temperatures may vary according to seasonal conditions.

Chick behavior as your management guide. Watching the chicks is the best way to determine their needs. Visit the brooder house four or five times during the day. Make your last check after the birds have bedded down for the night. Comfortable chicks will spread out evenly under an electric hover or settle down in a circle about 6 inches from the edge of a gas, oil, wood, or coal brooder. *Chilled birds* will huddle and crowd close to the stove. Shrill chirping is indicative of a bird's distress. Prolonged chilling or exposure to drafts may help bring on stunting of the brood, severe outbreaks of diarrhea and pneumonia, and an increased susceptibility to disease. If the birds pile up in an effort to keep warm, losses from suffocation may result. *Overheated birds* are listless and inactive. They try to push as far from the source of heat as possible. Excessive heat will make them pant and gasp for breath. Their wings will be pushed out from their bodies. Overheating may cause slow gains in weight, poor feathering, constipation, costly outbreaks of cannibalism, lung congestion, and a drastic increase in brooder mortality.

Damp Poultry Houses. Dampness must be avoided at all costs! A deep, dry layer of litter helps maintain the health of the flock and encourages the maximum production of eggs and gains in weight. The best weapon against dampness is a clean, dry, and highly absorbent litter. There are a number of materials suitable for use as poultry house litter. They include peat moss, crushed sugar cane, wood shavings, ground corn cobs, and chopped straw. The hulls of cotton seed, peanuts, oats, and rice also may be used where supplies are plentiful. If properly handled, any of these materials will help provide dry quarters. Under no conditions should moldy litter be used, for doing so may lead to the development of brooder pneumonia or aspergillosis. (*See Page 160.*) The use of old or compost litter for young, growing or adult stock is not recommended. Poultry manure may be a teeming reservoir of infectious bacteria and parasites. And since parasite eggs and bacteria must have moisture to exist, a dry atmosphere helps destroy them. It will prove much cheaper to prevent disease with a deep, dry litter than with prophylactic drugs. A deep litter serves another useful purpose in that the layers of warm material provide insulation against chilling floor drafts. To prevent wet litter follow these simple rules:

1. Start with 2 to 4 inches of a clean, dry litter and gradually increase to a depth of 5 or 6 inches. In areas that have cold, wet winters 8 inches of litter is recommended for older birds.

2. Rake and stir the litter daily. Watch the danger spots under the hover and in the feeding and watering areas. Gasoline driven, mechanical stirrers are suggested for use on large poultry farms.

3. Break up any packed litter. Moisture evaporates more quickly from loose material. Either remove wet spots or thoroughly mix the litter with fresh, absorbent material. Hydrated lime or limestone may be mixed in with the litter at a weekly rate of 25 to 30 pounds for every 100 hens or 200 to 300 chicks housed.

4. Keep electric brooders well insulated, and use hover fans to assure maximum ventilation. Moisture problems are reduced to a minimum if sufficient heat and free circulation of air are provided.

5. Put water fountains on wire mesh platforms to prevent wet spots in the area. If center island roosts are used, a thin layer of litter will help absorb the moisture from droppings and from water spillage.

Discouraging Litter Eating. Scatter mash over egg case flats when the chicks are first taken out of their boxes. Keep chick hoppers filled. Put burlap, canvas, or paper sacks over the litter for the first three or four days of brooding. The accumulated droppings should be removed every day. A convenient system consists of putting several layers of wrapping paper on the floor and removing one layer each day until the danger of litter eating has passed.

Supplying Fresh Air. Circulation of cool, fresh air is needed at all times. Excessive heat retards growth by decreasing feed consumption. Windows should be kept open as much as outside conditions will allow. When brooder stoves are in use, some openings should remain at all times for the escape of the gases of combustion; otherwise, entire broods may die of carbon monoxide poisoning. Examine gas, coal, or oil heaters and repair or replace any worn or faulty parts. Follow the manufacturer's directions for operation of all brooding equipment.

Early Roosting to Conserve Space. Chicks may be taught to roost when they are from four to six weeks old. Early roosting will help reduce overcrowding and prevent litter-borne infections.

Construct roosts of 2" x 1" boards and round off the sharp edges. Place the roosting bars 1 foot above the floor and nail them to a frame covered with 1-inch wire mesh. Hinge the frame to the back wall and fasten the wire at the back to prevent the chicks from getting at the droppings.

When chicks are first beginning to roost, take time out to run them up at night until they have become accustomed to the roosting boards. Keep the following points in mind if roosts are to be included in your brooding program:

1. All edges of roosting bars should be smooth. Avoid the use of sharp, narrow roosts. For the first six weeks provide a minimum roosting space of 3 to 4 inches per chick and 6 inches for chicks up to 12 weeks of age.

2. All roosts should be treated with carbolineum or other similar coal tar products as protection against red mites. Painted roosts must be thoroughly dried before being used.

3. Roosting in chicks younger than four weeks of age should be discouraged. Heavy, meat-type birds, or those broilers and fryers inclined to the development of breast blisters or crooked keel bones should not be allowed to roost.

Outdoors or Indoors? One of the time-worn controversies of poultry farming concerns the advantages and disadvantages of rearing pullets *in confinement* and *semi-confinement* or of giving them *free access to poultry range*. Under the confinement system birds are kept in houses or pens from the time they hatch until they reach the cull crate and stewing pot. Semi-confinement calls for the use of outdoor runs, porches, or yards that adjoin the pens. The basic arguments advanced for the semi-confinement method are as follows: (The third system of raising birds on range is discussed fully in Chapter 9.)

1. *The use of outdoor porches or runs increases the capacity of growing pens.* If we could depend on continual sunshine and fair weather, this claim would be justified. Unfortunately, on rainy, foggy, or cold days the birds stay indoors and the "increased capacity" disappears in the wake of overcrowded pens and damp litter. Do not depend on runs or porches to increase the capacity of your housing unless you can also depend on the weather.

2. *Porches and runs afford the growing birds an opportunity to get plenty of sunshine and vitamin D.* This is true. However, vitamin D can be supplied easily, and at moderate cost, through the feeding of cod liver oil or synthetic oils.

3. *Birds too closely confined in houses tend to develop cannibalistic habits.* They will not, however, if properly managed and given well-balanced diets. Birds kept indoors *or out* must have adequate floor space and facilities for feeding and watering. Effective measures to control the common chicken vices, should they occur, are discussed on Page 171.

4. *Birds reared on wire porches are less likely to become parasite-infested than flocks reared on the floor.* The validity of this argument cannot be questioned. But floor birds need not suffer from internal parasites if their litter is 6 to 8 inches deep and kept reasonably dry. When necessary, drugs to prevent or control parasitic conditions may be administered in the feed or water. Tapeworms are transmitted by way of insects, such as the common fly. Wire runs or cages offer no protection against tapeworm infestations. Droppings on concrete or dirt floors where no litter is used often produce conditions that are ideal for the breeding of flies.

Few real advantages are to be gained by the use of outdoor runs or porches in most sections of the country. A range system of management may be considered if sufficient land is available. If your farm acreage is limited, the confinement system of raising chicks and replacement pullets is recommended.

Chapter 7

FEEDING THE YOUNG AND GROWING BIRD

FORMULAS FOR COMMERCIALLY PREPARED OR farm-mixed rations vary according to the age of the birds and whether they are being raised for meat or egg production. All diets, however, should consist of a properly balanced supply of proteins, carbohydrates, minerals, and vitamins. The rations should be fresh, wholesome, and palatable.

Protein. This keystone nutrient, is utilized in the building and repairing of body tissues, such as blood and muscle. A 21 per cent protein feed is needed for the first six to eight weeks of a chick's life. (It is during this period that the chick's body weight increases 12 fold.) Levels may be reduced gradually after this critical growing period because the protein needs of the body diminish. Chicks from 8 to 12 weeks of age will thrive on diets consisting of 16 to 18 per cent protein. Mature hens are able to sustain a high rate of egg production on rations containing as little as 15 per cent protein. All chicken feed should contain protein concentrates from a variety of plant and animal sources. Plant supplements that may be used include soy bean meal, cottonseed meal, peanut meal, corn gluten meal, alfalfa leaf meal, wheat middlings, and wheat bran. Animal sources include meat or tankage, dried blood, and milk by-products.

Carbohydrates. Making up 50 per cent or more of poultry rations, carbohydrates supply the energy food necessary for carrying out the vital functions of life. As the protein needs of the body decrease, the slack in the ration is taken up by the carbohydrate-rich grains and their by-products. The grains most commonly used are yellow corn, wheat, oats, barley, and the grain sorghums. They may be given to supplement regular mash feedings as the birds get older. Carbohydrates are usually listed on feed tags as nitrogen-free-extract (NFX) and crude fiber. The former refers to the easily digested sugars and starches. The crude fiber, or cellulose, is a highly indigestible carbohydrate that adds bulk, but little nutritive value, to the feed.

Minerals. Calcium, potassium, phosphorus, magnesium, sulphur, iron, and copper contribute to the health and normal functioning of body tissues. Starter and grower mashes are usually rich in these minerals. The rations must be fortified by the addition of salt and manganese sulfate. Manganese acts in conjunction with the vitamins choline and biotin to help prevent *crippling attacks of slipped tendon disease (perosis) in growing chicks.* Diets that are deficient in salt are apt to bring on stunting or cannibalism. Salt deficiencies in adult diets may interfere seriously with normal egg production.

Calcium and Phosphorus. These two elements are needed for the formation of strong bones. Among the feeds rich in calcium are bone meal, fish and animal tankage, and alfalfa leaf meal. Grains and grain by-products contain a plentiful supply of phosphorus. Supplementary feedings of calcium in the form of hard limestone or shell are given to mature fowl during the months of egg production.

Vitamins A and D. In the form of cod liver oil or other feeding oils or concentrates, these vitamins are commonly added to poultry rations. Vitamin D helps prevent rickets in young birds. It is also needed in adult diets for the production of normal egg shell. Vitamin A is recognized as being helpful in preventing colds and "nutritional roup." (*See also Page 179 and vitamin chart on Page 198.*)

Water. *Though birds can survive for days without food, they will collapse* in a short time without water. It serves as an aid to digestion; it helps the blood and lymph streams transport digested materials to body tissues and return waste products to the kidneys and lungs; and it acts as a temperature equalizer through the process of evaporation from the air sacs, lungs, and skin. Water is also needed for making the fluids that help lubricate the joints.

Keep clean, fresh water in front of the birds. One-hundred-day-old chicks will consume 4 quarts of water a day. One hundred six-week-old birds will use 3 to 5 gallons of water a day. As your chicks grow, anticipate and satisfy their increased demands for water.

Growth-Stimulating Factors. Chick growth can be enhanced by the use of the antibiotic drugs, such as aureomycin, penicillin, terramycin, bacitracin, chloromycetin, and neomycin, and by arsonic acid, vitamin B12, and various other drugs. The use of these factors has met with widespread acceptance by members of the broiler and fryer industries. High-level feedings of the antibiotics such as terramycin and aureomycin may prove useful in treating or preventing certain poultry diseases. Healthy adult birds will derive little or no benefit from the addition of these ingredients to their regular diets. Antibiotics fed to breeding flocks will not influence the fertility, hatchability, or livability of the chicks produced.

Suggestions for Feeding Young Chicks. Feeding practices can have more influence than any other management factor on the outcome of your poultry

enterprise. The successful farmer knows *how* to feed as well as *what* to feed his flock. For example:

1. Feed chicks immediately after moving them from the chick box to the brooder. A handful of hard, chick-size grit should be sprinkled over the mash.

2. Distribute feed hoppers evenly throughout the brooding area. For the first week, put hoppers close to the edges of the hover. Put water fountains (quart size) where they will always be accessible.

3. *Provide* adequate feeding facilities. Most of the chicks should be able to eat at the same time. Do not let chick hoppers remain empty for more than 30 minutes at a time. The birds should be able to eat as much and as often as they like. Let them clean up the hoppers once a day.

4. Feeding grain to day-old chicks to prevent "pasting up" may get the brood off to a slow start. The underlying causes of pasty vents, such as chilling, overcrowding, and pullorum disease, cannot be corrected by dietary changes alone.

5. Start regular grain feedings any time after six weeks. Feed grit from separate hoppers or scatter some on top of the mash once or twice a week.

6. Adequate amounts of calcium are found in chick starter and grower mashes. Extra shell feedings are not necessary until the birds have started to lay.

7. Green feeds, such as lawn clippings, finely cut alfalfa, and clover, may be fed after three weeks. Feed costs are lowered if green feed is available in sufficient quantities.

8. *Do not use coarse, long-stemmed grasses.* Fatal crop impactions may develop. Free range is desirable after eight weeks.

9. Chick-size and granulated pellets may be substituted for regular mash feedings, or they may be used as a supplementary feeding to increase feed consumption.

CHART 5

Age	*Pounds of Grain Mixture (10% Protein) for Each 100 Pounds Starter Mash (20% Protein)*	*Recommended Protein Level (Percentage)*
1 to 6 weeks	All mash diet; no grain	20 to 21
7 to 8 weeks	10 lb. (2 divided feedings)	18 to 19
8 to 9 weeks	20 lb.	17 to 18
10 to 12 weeks	40 lb.	16 to 17
13 to 14 weeks	60 lb.	15 to 16
15 weeks	80 lb.	15 to 16
*16 weeks	100 lb. (⅓ in A.M., ⅔ in P.M.)	15 to 16

* A mixture of 100 pounds of grain (10 per cent protein) and 100 pounds of a 20 per cent mash represents a 15 per cent protein diet and is considered adequate for most pullets after 16 weeks of age.

10. Clean feed hoppers once a day. Mix any leftover feed in the hoppers with fresh mash.

11. When you replace feed hoppers, give the chicks a chance to become familiar with the new equipment before removing the old hoppers.

Recommended grain feedings for chicks to 16 weeks of age are given in Chart 5.

CHART 6

EQUIPMENT NEEDED FOR FEEDING AND WATERING

Age of Birds	*Number and Size of Hoppers (per 100 birds)*	*Daily Water Consumption (per 100 birds)*
1 to 3 days	1 egg case flat, or paper plate, plus chick-size hoppers	6 to 8 quarts
3 days to 3 weeks	Two 36-inch hoppers, open both sides	6 to 8 quarts (Automatic fountains may be started at two weeks.)
4 to 6 weeks	Two 60-inch hoppers, open both sides	*6 gallons
7 to 12 weeks	Two 8-foot hoppers, open both sides	*6 to 8 gallons
12 to 24 weeks	Five 5-foot hoppers, open both sides	*6 to 8 gallons

* If automatic fountains, dew drops, cups, or other watering devices are used, follow the manufacturer's directions as to capacity. Mechanical feeders usually allow 1 foot of feeding space per six to eight adult birds.

Chapter 8

HOW TO REDUCE CHICK AND PULLET MORTALITY

START YOUR CULLING EARLY. PROMPT DETECtion and removal of sick, weak, or deformed birds helps prevent costly disease outbreaks. Start a continuous culling program the day your baby chicks arrive, and keep it up until they are sold as broilers or disposed of as old hens. Culling will help you get a fair salvage price for birds that might otherwise end up in the incinerator. More efficient use of floor space, a reduction in feed costs, and a savings in labor are only a few of the benefits derived from a continuous and thorough culling program.

A high percentage of cull birds observed during the brooding or growing period should prompt you to seek expert help at once. Call your local veterinarian, or consult state poultry pathologists for assistance in determining the cause of your particular problem. Avoid faulty use of drugs. *An accurate diagnosis is the key to effective treatment.*

Discomfort Breeds Cannibalism. Active, well-fed chicks usually keep out of trouble. Subjected to hunger, cold, or overcrowded and overheated conditions these same chicks may acquire vicious, cannibalistic habits. Certain strains of birds are prone to develop vices such as cannibalism, toe picking, and feather pulling. On occasion, one encounters certain broods that seem to defy all efforts to prevent them from picking each other to death. These vices can be prevented, or at least kept in check, by one or a combination of the following practices:

1. Avoid having too much light in the brooder house. Paint windows with an opaque, red poster paint when an outbreak occurs.
2. Use a 30 to 60-watt, red-colored bulb to supplement the natural lighting.
3. Keep a 10-watt bulb or kerosene lamp burning all night in the brooder house.
4. Provide sufficient salt in the chicks' diets, a minimum of 10 pounds of salt to each ton of mash (one-half pound per 100 pounds of mash). As

a corrective measure when an outbreak occurs, add one teaspoon of salt to a gallon of water and place it in front of the chicks.

5. Feed broods regularly. Mash should be in front of them at all times.

6. Maintain a cool, well-ventilated brooding area where the chicks can get away from the source of brooding heat.

7. Supplementary feedings of oats, and green feeds, such as lettuce, cabbage, lawn clippings, or clover, may reduce the incidence of cannibalism.

8. Anti-pick pastes may be used to discourage the spread of cannibalism in the brood. If picking persists in spite of the anti-pick paste treatment, the beaks of the offending birds may be cut back to the quick with a pen knife or with a mechanical debeaking machine that cauterizes as it cuts. (*See also Page 171 and Plate 39.*)

Pile-Ups and Smothering. Losses from pile-ups and smothering may be minimized by nailing slats or boards across the corners of the brooder house. Frightened or chilled birds are easily stampeded and will push and shove in an attempt to find a warm corner or to hide from frightening noises. Night visits of cats and other animals must be guarded against, and holes that might be used by rats or mice must be repaired.

Avoid sudden movements or noises when making your evening check of the brooding units. After the brood has settled down, push all stragglers into the hover area. Check the magazines of coal and wood burning stoves to make sure the fuel will last through the night. A thermostatically controlled alarm system may be installed that will go off when brooding temperatures drop below the margin of safety. The cost of such a system would be more than offset by the prevention of just one serious brooding accident.

Dead chicks and stunted pullets are usually the products of poor management. Far too many cases of poultry mortality could be prevented with common sense, sanitation, and sound management practices. The diseases and parasites affecting poultry and recommendations for diagnosis, treatment, and prevention of the individual conditions are described in Chapter 20.

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5. Feed broods regularly. Mash should be in front of them at all times.

6. Maintain a cool, well-ventilated brooding area where the chicks can get away from the source of brooding heat.

7. Supplementary feedings of oats, and green feeds, such as lettuce, cabbage, lawn clippings, or clover, may reduce the incidence of cannibalism.

8. Anti-pick pastes may be used to discourage the spread of cannibalism in the brood. If picking persists in spite of the anti-pick paste treatment, the beaks of the offending birds may be cut back to the quick with a pen knife or with a mechanical debeaking machine that cauterizes as it cuts. (*See also Page 171 and Plate 39.*)

Pile-Ups and Smothering. Losses from pile-ups and smothering may be minimized by nailing slats or boards across the corners of the brooder house. Frightened or chilled birds are easily stampeded and will push and shove in an attempt to find a warm corner or to hide from frightening noises. Night visits of cats and other animals must be guarded against, and holes that might be used by rats or mice must be repaired.

Avoid sudden movements or noises when making your evening check of the brooding units. After the brood has settled down, push all stragglers into the hover area. Check the magazines of coal and wood burning stoves to make sure the fuel will last through the night. A thermostatically controlled alarm system may be installed that will go off when brooding temperatures drop below the margin of safety. The cost of such a system would be more than offset by the prevention of just one serious brooding accident.

Dead chicks and stunted pullets are usually the products of poor management. Far too many cases of poultry mortality could be prevented with common sense, sanitation, and sound management practices. The diseases and parasites affecting poultry and recommendations for diagnosis, treatment, and prevention of the individual conditions are described in Chapter 20.

Chapter 9

RANGE MANAGEMENT

A WELL-PLANNED PROGRAM OF RAISING BIRDS on range has some advantages over the semi-confinement and confinement systems of management. Ranged pullets have access to grasses that are rich in protein and vitamins. This results in lowered feed costs. The requirements in land, equipment, and labor for starting and maintaining a range rearing program are as follows:

Acreage. The land to be used for permanent or semi-permanent range should be fertile, preferably a medium to heavy loam, and capable of supporting good yields of pasture grasses and cover crops. Low, poorly drained ground should not be used, for costly outbreaks of parasitism may result. However, wet spots on otherwise desirable land may be fenced off to keep the birds from grazing on these areas.

Each acre of poultry range may be stocked with 200 to 300 birds on well-sodded, permanent pasture and up to 500 pullets on a new stand of Ladino clover. But don't overestimate the capacity of the land. Overcrowding eventually will defeat the purpose of rearing birds on the ground. Allow sufficient acreage for a two or three-year rotation program. Ground should be used not more than once every two years, and preferably only once every three years. The intensive use and re-use of land by the flock will result in gross contamination of the soil with a subsequent increase in parasitic and bacterial diseases.

Range Crops. Your choice will depend on the type and fertility of the soil. The most widely used poultry range crop is Ladino clover. It may be seeded alone at the rate of 4 pounds per acre, or it may be combined with other grasses and legumes. A few of the more popular pasture mixtures are listed:

RANGE MIXTURES

(Per Acre)

Number 1	*Number 2*
6 lb. Perennial Rye Grass	15 lb. Kentucky Bluegrass
12 lb. Kentucky Bluegrass	10 lb. Timothy
2 lb. Ladino Clover	

Number 3
5 lb. Red Clover
2 lb. Alsike Clover
3 lb. Timothy
2 lb. Ladino Clover

Number 4
5 lb. Timothy
6 lb. Red Clover
3 lb. Alsike Clover
5 lb. Kentucky Bluegrass
2 lb. Ladino Clover

Winter wheat or rye seeded in the fall at the rate of 3 to 4 bushels per acre will provide a good growth for early spring range. Physical and chemical tests should be made of the soil to determine the amount of lime, superphosphate, manure, and other materials that must be added to the soil before the initial and subsequent seedings. Consult your county agent for help in selecting a pasture program to fit your needs. Remember that his agricultural training and his knowledge of local conditions make it possible for him to offer valuable assistance in your various farming problems.

Brooding Schedule. Your plan may determine, to a large extent, whether or not it will be advantageous to range your growing birds. It is the late spring and early summer broods that derive maximum benefit from the range crops. Pasture usually is not ready for the early spring or late winter chicks, and fall broods find little if any green grass remaining by the time they are old enough to graze. If you are contemplating many out-of-season broods or plan to adopt a multiple brooding schedule, you would do better to consider confinement rearing from the brooder to the laying house.

Range Housing. Facilities consist primarily of low-cost, portable shelters. Colony brooder houses may serve as supplementary housing units. A range shelter may be a light, wood framework measuring 8′ x 10′ or 10′ x 10′ covered with wire netting to assure maximum ventilation during the summer months. Roosting bars in the shelter help establish perching habits before the pullets are brought into the laying pens. Roosts usually are made of 1″ x 2″ lumber that is rounded on the edges to prevent breast and keel injuries. At least 6 inches of roosting space is allowed for Leghorns and 7 inches for heavy pullets. Roosts are spaced 1 foot apart to prevent overcrowding. The shelter floor is covered with 1″ x 2″, 14-gauge welded wire. The droppings fall out of reach of the birds and are cleaned out once a month, or more often if necessary. A 10′ x 10′ shelter will hold 100 pullets until shortly before they come into production.

Range Equipment. Included should be wind and rain-proof mash and shell hoppers, and water fountains or automatic watering systems. Nesting facilities should be added as the birds approach maturity. (*Pullets usually are placed in laying houses when 10 per cent of the birds begin production.*) There are many types of range feeders on the market. The so-called "self feeder," which will hold several days supply of feed, lends itself to range conditions. You may want to build your own feed hoppers. Construction plans are obtainable from State Agricultural Extension Departments or local feed companies.

Water supplies should be piped to the range to minimize labor. Watering systems or fountains equipped with automatic float valves will assure a continuous flow of fresh water. Lines should be placed underground to prevent overheating of the water during summer months.

Labor. With the development of mechanized equipment, birds confined to permanent brooder houses can be cared for in less time than an equal number of pullets kept under range conditions. On the range, feed must be carted over longer distances. If water lines are not run out to the range, a long haul from faucet or water truck is necessary. The shelters of ranged birds must be locked at dusk and then re-opened in the morning as a protection against predatory animals. These are a few of the time-consuming yet essential chores that must be performed if a range rearing program is to yield good results. Savings in labor cannot be considered one of the advantages of raising birds on range.

Many factors are involved in establishing a successful management program. These include the following:

Shade. Growing pullets will not eat or drink freely if their food and water is placed in unshaded areas. Shade may be provided by wooden frames covered with burlap sacks, brush, or aluminum sheeting. Plants such as corn, Jerusalem artichokes, or sunflowers will give adequate shade. The young plants should be fenced off until they are tall enough to withstand being trampled by the birds. Sudan grass may be planted in 2-foot strips, with alternate rows cut periodically during the ranging season. One row will provide a supply of succulent grass for the birds and the other row will provide protection from the sun.

Adequate shade is desirable, but it is equally important to protect the birds from excessive dampness. If shelters, hoppers, or fountains are placed in wooded areas, have the tops of the trees trimmed back enough to let sunlight get through to the ground during part of the day.

Fences. Temporary or permanent fencing serves two purposes: It confines the birds to range, and it keeps predatory animals out. Fences need to be at least 7 feet high and 1 to 3 feet underground. A single strand of barbed wire on top of the fence will discourage the birds from using the fence as a roosting bar. To avoid the problem of tree roosting, the wing tips of day-old chicks may be clipped. If wooden fence posts are to be used, they should be chemically treated with creosote, carbolineum, or other wood preservatives to prevent rotting. Posts that have been pressure treated with creosote or a 5 per cent solution of pentachlorophenol may be purchased at most lumber yards. Treated posts will resist rotting for relatively long periods of time. Place the wooden posts no farther apart than 10 feet for maximum fence strength. Steel posts may be set 12 feet apart. Corner posts should be 8 inches or more in diameter and placed at least 4 feet in the ground. The rental of a tractor-driven, post hole digger will eliminate much of the back breaking work associated with building fences.

A single strand of electric fence wire strung 6 to 8 inches from the fence and 8 inches above the ground will help discourage the visits of predatory animals. Two strands may be used, the first placed 6 inches and the second 12 inches above the ground. Electric fence equipment may be purchased at farm supply stores. A 4-foot-wide area around the outside of the fence should be sprayed with a weed killer (2,4-D or Ammate or 2,4,5-T) to prevent weeds from short circuiting the electric wire. A mixture consisting of equal parts of carbolineum and kerosene also may be used.

Other methods of discouraging wildlife include installing flood lights on the range or setting up a communication system between the range and the house so any unusual noises may be detected and investigated.

Mowing. Frequent cutting of range crops is recommended for best results. As grasses mature, the percentage of fiber (*the relatively indigestible portion of the plant*) increases in proportion to the more succulent parts. The more your flocks consume the low-cut grasses and clovers, the greater will be your savings in feed costs. Furthermore, tall grass will get knocked down and matted by the birds. The ground underneath matted areas will tend to remain damp, thus encouraging the growth of poultry parasites. From a nutritional, financial, and sanitary standpoint, low-cut, frequently mowed grass is best for the flock throughout the growing season.

Segregation. Keep different age groups separated. Do not mix old hens with pullet flocks. In this way, problems of culling, housing, and vaccination will be minimized. Cockerels should be removed from pullet ranges early. Leghorn cockerels may be recognized from six to eight weeks of age, heavy breed males from eight to ten weeks. If cockerels are to be kept for fattening, caponizing, or breeding purposes, they should be ranged and housed apart from the pullet flock.

Placing of Equipment. Range shelters need to be 150 to 200 feet apart. They should be moved to new locations (*25 feet from the old spot*) on the average of once every two to three weeks. When moving shelters, remove accumulated droppings to screened compost heaps or manure piles. Feed hoppers and water fountains should be moved 25 feet every two to three weeks to help keep the ground from becoming contaminated. However, do not place feeding and watering facilities more than 100 feet from the range shelters; birds will not travel far from their shelters to seek food and water.

Feeding Range Birds. For maximum savings in feed costs, a program of restricted feeding and the use of specially formulated range mash mixtures is recommended. Under the restricted feeding schedule, hoppers or flat feeders containing the growing mashes are kept closed for three to five hours a day. Thus the birds are forced to take advantage of the protein and vitamin-rich grasses and whatever insects they may find. The feed hoppers are left open during the mid-afternoon. A late afternoon feeding of grain or pellets may be scattered on the ground.

Experiments conducted at the Ohio Agricultural Experiment Station at

Wooster, Ohio, indicate that a good growth of Ladino clover (*supporting 250 to 500 birds to the acre*) will provide an adequate level of protein and vitamins essential to chick and pullet growth and development. The only supplementary feeds placed before the birds consisted of whole corn (fed free choice) and a mash made up of 90 parts ground corn, 2 parts oyster shell or limestone grit, 2 parts salt, and 2 parts feeding-grade bone meal. Two parts of granite or gravel grit also were added to this mixture. The whole and ground corn and a mineral mash ration was fed daily from two separate feeders. The feeders were not more than 4 to 5 inches in width and depth and were only half filled. The birds were usually fed at 4 o'clock in the afternoon and given only as much of the special mash as they would consume by noon the following day. Similar feeding trials conducted by the Cornell University Agricultural Experiment Station also showed favorable results, with the birds being ranged on a Kentucky Bluegrass and Ladino clover mixture. If grass crops are poor, growing mash should be kept before the birds at all times.

Schedule your filling of mash hoppers as an early morning chore. Mix fresh mash with whatever ingredients are left from the previous day's feeding. Do not fill hoppers more than three-quarters full to minimize feed waste. Keep grit and shell hoppers full. Check water supplies during the early morning rounds. Be sure that fountains are full and that automatic valves, floats, and other parts of the mechanical systems are in working order. Carry spare parts and tools for the repair of water fountains. This practice may save many needless and time-consuming trips back to the work shop.

Schedule a late afternoon grain or pellet feeding. The grain may be scattered directly on the ground from lime spreaders or from the back of an open truck. In the event of rain, place grain feedings in the protected mash hoppers. If high winds are causing excessive waste, pellets may be used as a substitute for the mash. Pellets also may be mixed with mash in equal proportions if it becomes necessary to increase feed consumption.

Culling. A continuous grading and culling program should be carried out while the pullets are on range. Look over the birds when you are locking them in for the night. Handle a few in each shelter and eliminate any stunted or sickly birds. If possible, arrange a 100 per cent inspection of the flock when the birds are 12 to 16 weeks old and again at 20 weeks. This handling may occur at the time the flock is caught up for vaccination or deworming. A full discussion of selection factors involved in culling is presented on Pages 102-104.

The Final Move. When 10 per cent of the flock has commenced to lay, it is time for a move from shelter to laying house. If only one laying pen is to be filled at a time, carefully select those birds that show evidence of having begun to lay or that are about to lay. (*See Page 102.*) Moving should be done at night. The birds are handled more easily and are less frightened

when they are picked off their roosts, crated, and transported in the dark. Move one range feeder and water fountain into the laying pen and wait until the birds become accustomed to their new equipment before removing the old feeder and fountain. If nighttime moves are not feasible, round the birds up at night and confine them to the shelters until you are ready to move them the next morning. Do not crate and move birds during the heat of the day.

PREVENTING RANGE MORTALITY

Management of the range flock from 8 to 12 weeks of age may determine whether you house profitable birds or only marginal layers. A few management suggestions that will help assure your housing healthy pullets are listed:

1. *Avoid overcrowding.* Crowding birds on range may cause serious problems with roundworm and tapeworm infestations. Parasitized birds are more susceptible to other poultry diseases, including the insidious chronic respiratory disease.

2. *Practice a three-year range rotation program.* Infectious organisms can live in the ground from one season to the next. They are able to reinfect new flocks when the birds are first put out to range. There is no better health insurance for your birds than a planned rotation of range.

3. *Check the shelter roosts for signs of red mites.* Examine the birds periodically for evidence of lice and grey mite infestations. (*See Chart 21, Page 203.*) Treat roosting boards with carbolineum or other mite repellents three weeks before the shelters are to be used.

4. *Plan your vaccination program.* Newcastle, bronchitis, fowl pox, and laryngotracheitis are among the diseases that you may need to vaccinate against. All vaccinations should be completed at least one month before the flock is due to lay. Do not vaccinate flocks that are suffering from parasites or disease. Consult a local veterinarian or write your State Poultry Disease Laboratory for specific recommendations. (*See discussion of vaccination procedures on Page 220. A list of the addresses of poultry disease laboratories is on Page 230.*)

5. *Do not deworm your flocks unless a definite diagnosis has been made* as a result of post-mortem examinations. Roundworms may be handled by intermittent feeding of nicotine-sulfate in the mash. Control of the intermediate hosts of the tapeworm such as slugs, snails, flies and other insects, is still the best approach to the tapeworm problem. (*See Page 201.*)

6. *Separate young and old birds* to help minimize the spread of adult diseases, including range paralysis and big liver disease. (*See Page 161.*)

Chapter 10

SURGICAL AND CHEMICAL CAPONIZING

SURGICAL

CAPONS ARE MALE BIRDS WHOSE TESTICLES have been surgically removed. The castrated cockerels, if properly fed and cared for, yield highly desirable carcasses which find a ready and a profitable market. Capons are usually dressed off before they reach ten months of age. By definition, their carcasses are "tender-meated with soft, pliable, smooth-textured skin." Dual purpose or meat-type birds are best suited for the production of capons. New Hampshires, Rhode Island Reds, Wyandottes, Barred and White Plymouth Rocks, and their crosses may be used. The heavy breeds such as the Langshan and Jersey Giant also make excellent capons.

When to Operate. Most capons are marketed during the Thanksgiving and Christmas holiday seasons. However, the demand for this type of poultry usually continues until Easter. In order to have the birds ready for market during these months, the selection of cockerels must be scheduled during the late spring and early summer months. Some farmers find it profitable to raise one crop of capons picked from their spring broods. Surplus carcasses are then placed in deep freezers until they are sold. Capons should be fed and fattened for approximately seven to nine months following the operation.

Age to Operate. Cockerels from six to eight weeks of age and weighing 1 to 2 pounds are the best subjects for the caponizing operation. Young male birds at this age are vigorous enough to withstand the shock of the operation and have not as yet developed any of the typical secondary male sexual characteristics. Older birds and those over 2 pounds in weight are apt to be poor surgical risks.

Preparation for the Operation. Surgical procedures are facilitated if the bird has an empty digestive tract. If the intestines are filled with food, the location and removal of the testicles is made increasingly difficult. All cockerels to be caponized should be placed in crates or cages and starved

for 12 to 24 hours preceding the operation. All solid food should be withheld, but a constant supply of clean water must be available.

The operation is usually performed on a restraining board similar to the one shown in Plate 9. The board is placed on a table or barrel and the height adjusted to a comfortable position for the operator. The instruments to be used for the operation should be sterilized by boiling and then immersed in alcohol or a solution of quaternary ammonium compound. A scalpel or sharp knife for making the incision, a rib spreader, a hook for tearing the membranes in the abdominal cavity, a forceps for grasping the testicles, and a pair of tweezers should be included in the surgical kit.

The Operation. Restrain the bird by securing both legs and wings with weighted cords or leather thongs. The breast of the bird should face the operator. Moisten the feathers lying over the last two ribs and remove them. Swab the underlying skin with alcohol, tincture of iodine, or metaphen. Chickens are fairly resistant to post-operative bacterial infections, but losses will be minimized by exercising some care in performing this and other operations. A source of good light is essential. Some men prefer to carry out the work under the direct rays of the sun. However, a strong light and reflector (a goose-neck lamp is excellent) will usually provide adequate illumination.

With the cockerel properly restrained, draw the skin taut over the operative site by pulling it toward the thigh or hip of the bird. Make the incision with the sharp knife or scalpel between the last two ribs of the body. (*See Plate 9.*) The incision should be from 1 to 1 and one-half inches in length. The opening should be large enough for you to work in. A 1-inch incision will heal just as fast as one that is only one-quarter inch long.

Place the rib spreaders between the two ribs and enlarge the opening until it is one-half to two-thirds of an inch wide. A fine membrane, called the omentum, lies immediately beyond the opening. This membrane may be torn apart using the pointed hook or the tip of the scalpel. After the membrane has been removed, the upper testicle may be seen near the backbone behind the lungs. (*See Plate 10.*) It is yellow in color and about the size and shape of a navy bean. The most delicate part of the operation must now be performed. Carefully insert the forceps, or a similar instrument, into the body cavity and grasp the testicle firmly. Make certain that the spermatic artery attached to the testicle is *not* included in the bite of the forceps. If this artery is ruptured almost certain death from hemorrhage will result. With a slow, twisting motion tear the testicle away from its attachment to the spermatic cord, and remove it from the body cavity. If both testicles are to be removed from the same incision, *the lower testicle should be removed first.* (*See Plate 11.*) Some bleeding, but not enough to be dangerous, will occur as the testicle is torn loose. Until you have mastered the technique, it is advisable to turn the bird over on its opposite side and make a new incision for the removal of the second testicle.

Post-Operative Care. Return the birds to their pens. Do not mix the capons with unaltered cockerels or with birds of different ages or sizes. Feed wet mash, pellets, or antibiotic mashes for three to four days following the operation. Grain feedings (50 parts of cracked corn and wheat to 50 parts of mash) may be started within three days after the operation. (*See Plate 12.*)

Wind or air puffs may develop seven to ten days after caponization. This condition is caused by an accumulation of air under the skin, particularly in the region of the operative wounds. When the bird is handled, a crackling sound is heard as the pockets of air are moved. Wind puffs may be cleared up by piercing the skin with a sharp knife and forcing the air out. The procedure may be repeated until the symptoms have disappeared. Another technique that may work consists of placing a piece of thread through the skin and tying the ends together. The thread may be left in the skin and eventually disappears.

Slips are cockerels that have not been properly castrated, part of one or both testicles remaining in the body cavity. Such birds retain their masculine traits and characteristics of development, but usually they do not produce enough viable sperm to assure fertility. These birds may be treated with the synthetic female hormone, diethylstilbestrol, and disposed of at an early age as "caponettes," or hormonized chickens.

CHEMICAL CAPONIZING

Hormonizing. The practice of injecting both cockerel and pullet chicks with the synthetic female hormone, diethylstilbestrol, has become widespread. Injection of a pellet or paste containing 15 milligrams of the chemical produces an increase in feed consumption, an improvement in finish, faster feathering, and an increase in fat deposition. Treated cockerels lose their mating instincts and stop crowing. Their combs and wattles remain small in size. The fighting instinct is also suppressed.

Cockerels are usually treated when they are from six to nine weeks of age. The pellet or paste is placed under the bird's skin, high on the neck near the skull. The injecting or implanting instruments are usually stocked by feed stores that carry the paste or pellet form of the chemical. It is important to inject the drug properly so that residue remains on that part of the head that is discarded when the bird is killed and dressed. Birds to be hormonized should be in peak condition at the time of the operation. The same precautions that apply to flock vaccination apply to hormonizing. Chemical or surgical caponization are "stress factors" that may touch off a latent infection, such as chronic respiratory disease.

The effects of the diethylstilbestrol wear off in six to eight weeks. Treated cockerels should be marketed when they are from 12 to 14 weeks of age. If heavier or older cap[illegible] uld receive a second

injection of the pellet or paste. Pullets also may be treated when they are six to nine weeks old. However, they should be readied for market one to two weeks ahead of the cockerels. If held over, an increase in the size of the intestines and reproductive organs will mean reduced dressing percentages.

CHART 7

UNITED STATES DEPARTMENT OF AGRICULTURE
GROWING MASH FOR CAPONS

Ingredient	*Parts by Weight*	*Ingredient*	*Parts by Weight*
Ground yellow corn	25.0	Riboflavin supplement (20 micrograms riboflavin per gram)*	6.0
Ground oats or wheat	10.0	Steamed bonemeal, defluorinated super-phosphate, or other low-fluorine calcium phosphate	3.0
Ground corn, wheat, barley, or grain sorghum	11.8	Ground limestone or oyster shell	2.0
Alfalfa leaf meal	5.0	*Manganized salt*	1.0
Soybean meal	21.0	Vitamin A and D feeding oil (300 I.C.U. vitamin D, and 1500 I.C.U. vitamin A per gram)†	0.2
Cottonseed meal, soybean meal, peanut meal, or corn-gluten meal	10.0		
Meat meal or fish meal	5.0		

* May be dried whey or fermentation products at appropriate levels.
† May be fish-oil vitamin A or provitamin A from vegetable sources. I.C.U. means International Chick Units, one unit being equal to 1.33 A.O.A.C. units.

CHART 8

UNITED STATES DEPARTMENT OF AGRICULTURE
FATTENING MASH FOR CAPONS

Ingredient	*Parts by Weight*
Ground corn	45.0
Finely ground oats, wheat, or barley	34.0
Meat meal	3.0
Soybean meal or corn-gluten meal	10.0
Dried milk by-products	6.0
Ground limestone	1.5
Salt	.5
	100.0

PART III

LAYING FLOCK MANAGEMENT

Chapter 11

SELECTING AND HOUSING THE PULLET FLOCK

SELECTING PULLETS. SUCCESSFUL MANAGEMENT of laying flocks begins with the housing of healthy, high-producing pullets. Start selecting pullets for the laying flock early in the brooding season. Remove sick or deformed chicks promptly. A cull bird, regardless of its age, consumes costly feed supplies and takes up valuable space. Cull birds rarely make up for the extra time and care needed to bring them around. Furthermore, a weak, deformed, or diseased chick may be a potential source of infection for the rest of the flock.

Schedule a complete handling or examination of the flock three times before they are moved to the laying houses from range shelters or growing pens. Make the first examination when the birds are six or eight weeks old. The cockerels and pullets may be separated and tracheitis and/or pox inoculations may be given at this time. A second handling should take place when the birds are 10 to 12 weeks old. Revaccination for Newcastle disease or the introduction of the bronchitis vaccine may be done at this time. (*See Page 220 for vaccination procedures.*) Make another examination of the flock at 18 or 20 weeks, or just prior to moving the birds from growing pens to laying houses. Once 10 per cent of the pullets have started to lay, the flock should be moved promptly to their permanent quarters.

During the examinations, grade the pullets according to their relative size, weight, and sexual development. Provide separate quarters for the various groups if possible. Small, non-aggressive pullets will often demonstrate remarkable growth rates when housed with birds of their own size. Late-maturing, but otherwise normal pullets (usually the last 10 per cent to start laying) should be watched closely. Signs of premature molting should prompt a careful physical examination of all the birds in the pen. Remove

the suspected culls. Isolate and dispose of any birds that have eyes with irregular, misshapen pupils, or that have wings or legs partially or completely paralyzed. Do not house thin, "razor breasted" pullets; they seldom mature into profitable layers. Isolate immediately any birds displaying recognizable symptoms of disease.

PULLET SELECTION GUIDE

Ready-to-lay pullets have:

1. Bright red, well-developed *combs* that are waxy and warm to the touch. A full comb is characteristic of a healthy, mature pullet.

2. *Beaks and shanks* that are deep yellow in color. As the pullets begin laying, the pigmented portions of the body start to bleach. (*See Page 103.*)

3. *Eyes* that are bright, clear, and amber-colored. The pupils should be perfectly shaped. (Do not confuse the naturally light-colored eyes of young chicks with the diseased condition known as "grey eye." (*See Page 162.*)

4. An *abdomen* that is full, soft, and pliable. A 1-and-one-half-inch to 3-inch spread between pelvic and keel bones. This span widens as the bird approaches maturity.

Immature or unhealthy pullets have:

1. Combs that are small or shrunken and cold and rough to the touch.

2. Pale and colorless beaks, shanks, and other pigmented parts. Paleness of beaks and shanks on pullets is usually indicative of poor health.

3. *Eyes that are dull and sunken.* Birds having irregularly shaped or discolored pupils should be removed from the flock.

4. *A pelvic-to-keel spread of less than 2 inches.* An abdomen that is firm and non-pliable. Pullets not in production by their sixth or seventh months should be sold as culls. Birds that are merely slow in maturing should be separated from their faster growing penmates.

Note: The yellow pigment in the tissues of the vent, eye-ring, beaks, and shanks (and ear lobes of Leghorns) will start to fade in a set pattern within a fairly definite time after the bird has started laying. The pigmentation returns when the production cycle ends. Any pullet showing signs of marked pigmentation at the base of her beak 30 to 40 days after flock production has started has yielded few eggs. She is of little or no value as a layer. (*See also Culling, Page 101.*)

Clean Quarters and Adequate Facilities. Proper conditions for feeding, watering, and nesting should be readied well ahead of housing dates. Don't rely on a last-minute rush job of cleaning, repairing, and disinfecting pens and equipment. When the pullets show signs of laying their first eggs, carefully check your housing situation. Doubling-up hen flocks may provide needed room for the early maturing pullets. Keep old hens that are producing at a rate of 50 per cent or better. One hundred birds approaching the end of their laying cycle should give you a minimum of 50 eggs a day.

(Layers housed in cages or batteries should produce four eggs a week.) If outdoor laying shelters are available, move older birds to these facilities as soon as possible and get the laying houses ready for new tenants.

Pen clean-ups should begin with the removal of old litter. Thoroughly sweep, soak down with lye, wash, scrub, and rinse the walls, ceilings, floors, nests, roosts, feed hoppers, and water fountains. Finish the job by applying a suitable disinfectant to destroy disease-producing bacteria and parasites. A combination of steam and water heated to 180 degrees is an excellent germicidal agent. (*See Plate 45.*) Cleansing solutions of quaternary ammonium compounds, used alone or combined with a detergent, are also effective poultry disinfectants.

Examine nests, roosts, and wooden equipment for mites or their typical "salt and pepper" trails. Mites can live for as long as 100 days in cracks and crevices after the pens have been emptied of birds. Treat wooden structures and equipment with carbolineum or other suitable chemicals. Scatter 3 inches of a clean, absorbent litter on the floor. Add to this amount each week until a 6-inch base has been established. Eight inches may be needed in cold, damp climates. Stirring the litter daily will help keep the pen dry. Fill the nests with wood shavings, excelsior pads, shredded sugar cane, or chopped straw. Before moving the birds, allow the disinfected pens and equipment to air dry for two or three days to assure complete dissipation of odors that might be absorbed by newly laid eggs.

Night moves are recommended for transferring pullets into the laying houses. Handle the birds with care, examining each to determine whether it is a likely candidate for the laying house, another week on range or in the growing pen, or a quick trip to the cull coop. Select those that are most mature or already in production. Fill the crates quickly, without overloading them. A few extra trips may prevent losses due to pile-ups and smothering. Unload the crates without delay.

If night moves are not convenient, schedule the chore for early morning. If the pullets are on range, close the shelters at night until you are ready to move the birds the following morning. Avoid handling or disturbing the flock in the heat of the day, since deaths from heat prostration may result. Pullets in production should be handled gently to prevent unnecessary shock to their reproductive organs. The use of catching crates, hooks, and nets will expedite the moving chore and minimize damage to the birds. (*See Figure 8.*)

Equipment from the range or growing pens should be placed in the new quarters for a few days. Let the birds grow accustomed to the new feeders and waterers before you remove their old equipment. If one or more feed hoppers are placed on the roosts for a short time, the birds will be encouraged to develop roosting habits early. Roosting problems also may be avoided by leaving a small bulb turned on at night for the first two weeks. Plan your chores to include a routine evening check of the new tenants.

Lift the nest perches at dusk to discourage the use of the nests or roosts during the night. The perches may be returned to their normal positions after the birds have settled down for the night. Make regular examinations of water fountains, including all working parts. Water is absolutely essential to the birds' health; the loss of a single day's supply may result in serious setbacks in health and egg production.

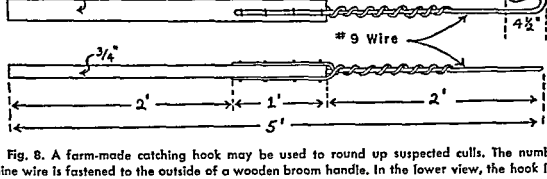

Fig. 8. A farm-made catching hook may be used to round up suspected culls. The number nine wire is fastened to the outside of a wooden broom handle. In the lower view, the hook lies flat and does not show. (Courtesy of the United States Department of Agriculture.)

If cannibalism has been a problem, all newly-housed pullets may be debeaked as a precautionary measure. One-half of the upper beak may be cut back to the quick with a penknife or electric cauterizing unit. Anti-pick devices, including "debeakers," blinders, shields, and spectacles may also be used. (*See Page 171.*)

EQUIPMENT RECOMMENDATIONS FOR THE LAYING FLOCK

Feed Hoppers. Allow 5 to 6 inches of hopper space for each bird housed, or 40 to 50 feet per 100 birds. If the grain feedings are scattered in the litter, 36 inches per 100 hens is considered adequate. Mechanical feeders usually allow 1 foot of feeding space per six or eight birds. These units should be adjusted and used according to the manufacturer's directions.

Grit and Shell Hoppers. Ground limestone or oyster shell may be mixed with the mash or fed from separate hoppers. If the birds are fed whole or cracked grain, they should be given access to hoppers that are filled with granite or some other *insoluble* form of grit. (*See Figures 9a and 9b.*)

Water Fountains. Recommendations for the use of water fountains will vary according to the type and design. One hundred mature birds consume approximately 8 gallons of water a day. One automatic fountain and pan, drinking cup, or jet may supply the needs of 100 birds. A 1-foot length of a V-shaped trough equipped with an automatic float also will provide adequate water supply for 100 birds. Additional water may be needed during the summer months. Provisions should be made with heating cable, tape, or similar devices, to keep the water from freezing in the wintertime.

Roosts. Allow a minimum of 6 to 7 inches of roosting space per Leghorn and 7 to 8 inches per heavy bird. Roosting bars may be constructed of 2″ x 2″ boards that have been rounded on the edges. They should be spaced 12 to 15 inches apart. All roosts and droppings boards or pits should be treated with carbolineum before the new pullets are housed.

Nests. Provide no less than one "hole," or nest, for every five hens. If community nests are used, allow 1 square foot for every five birds. A 2′ x 10′

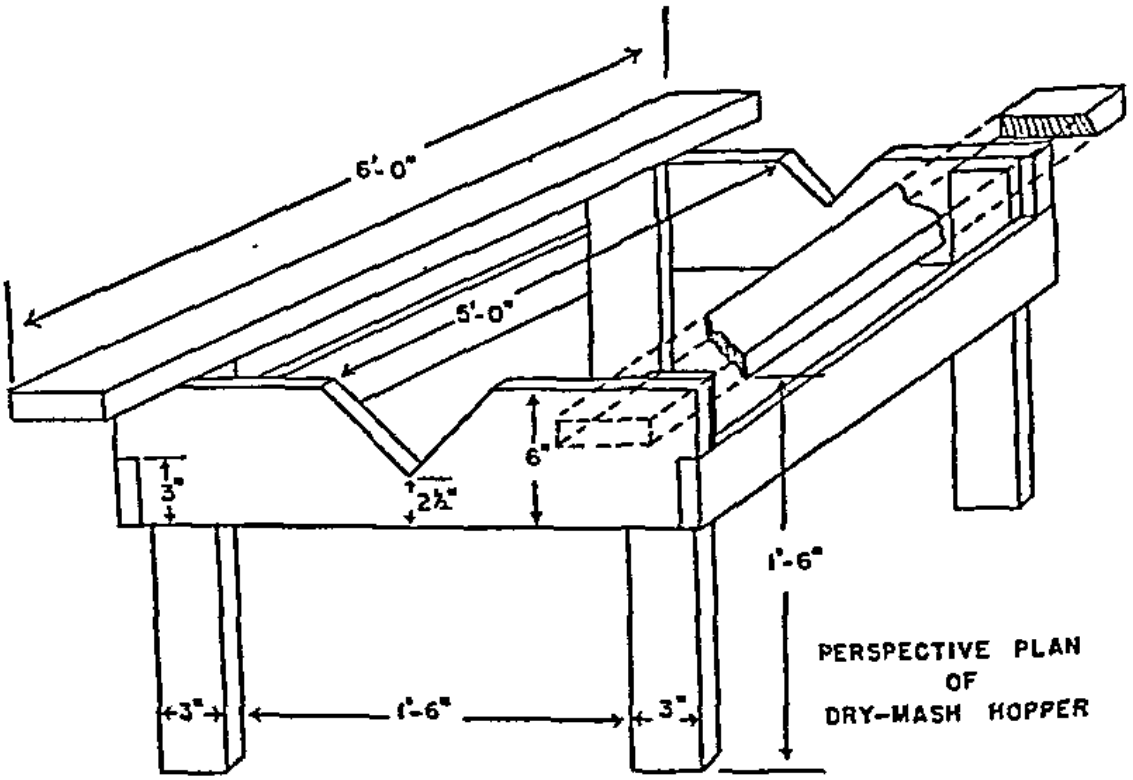

Fig. 9a

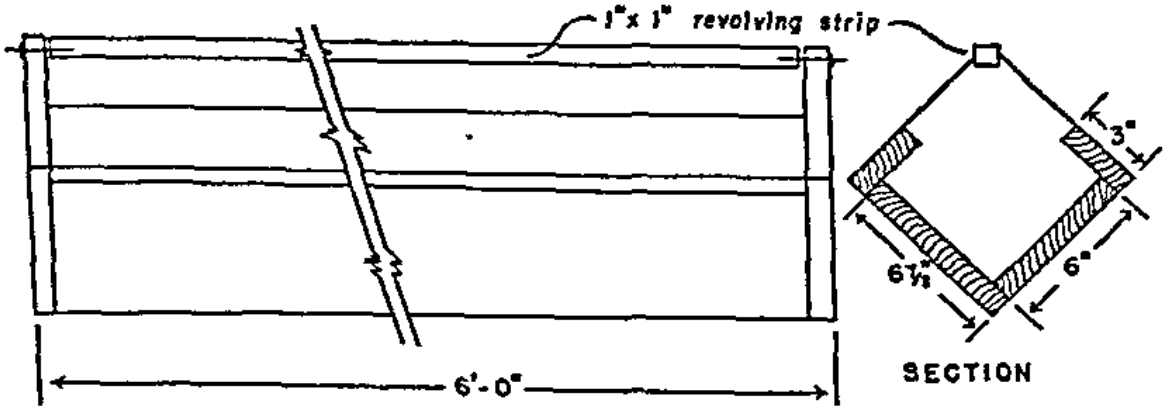

Fig. 9b

Figs. 9a and 9b. An indoor dry mash hopper (9a) for laying hens that may be easily constructed on the farm. The revolving strip (9b) will discourage birds from roosting on the feeder. Allow 1 foot of hopper feeding space for every five hens housed. (Courtesy of the United States Department of Agriculture.)

community nest, or a total area of 20 square feet, will suffice for 100 hens. Metal nests of the single hole type and community nests with roll-away wire bottoms are available at most poultry supply houses.

Litter. *Old litter should not be used for newly housed pullets.* Start out with 3 inches of a clean, absorbent litter. Clean litter should then be added each week until the covering is 6 to 8 inches deep. Keeping the litter dry with frequent stirrings is the best defense against coccidiosis and other filth-borne infections.

Lights. Electric outlets are needed in all laying pens. Artificial illumination is necessary to provide a minimum of 14 hours of light to help stimulate egg production during the fall and winter months. Two 40-watt bulbs will supply enough light for 100 to 125 hens. (*See also Page 77.*)

Chapter 12

HOW TO FEED THE LAYING FLOCK

SIXTY PER CENT OF EVERY DOLLAR YOU SPEND producing market eggs goes toward the purchase of feed supplies. No other factor plays a greater part in determining the over-all cost of your operation than the feeds you buy and your methods of feeding. Quality and economy are equally important. The rations you give to the laying flock must enable the birds to meet their energy needs, maintain good health, and also lay eggs at a profitable rate. (A laying bird should produce one dozen eggs on 5 and one-half to 6 pounds of feed.) The birds' vital needs are satisfied by the right amounts of protein, carbohydrates, minerals, and vitamins. A shortage of any one of these elements, or the use of poor quality ingredients, will reduce the efficiency of your feeding system.

All-Mash Diet. Providing mash containing 15 and one-half to 17 per cent protein is a simple and effective system of feeding. All-mash feeds are used widely by experienced and inexperienced farmers alike for feeding replacement pullets, laying flocks, and broilers. It is particularly suitable for use with mechanical feeders and on farms where children or non-skilled labor is used. A high mash intake will yield top-level egg production and maximum weight gains.

One drawback to the all-mash diet is the cost, which is greater than a mash and grain combination because of the necessity of grinding the supplementary grains added to the mash. A further objection is the increased packing down of the litter when an all-mash ration is fed. This can be partially overcome by daily stirring of the litter and by scattering a small early morning feeding of grain in the litter. Do not use more than 2 or 3 pounds of grain per 100 hens. If the grain feeding is given, a mash with a higher protein analysis must be used to compensate for the increased consumption of the low-protein grains.

High-Energy Ration. Mash having corn as the main ingredient is effective and economical for feeding broilers, replacement pullets, or laying birds. A high-energy mash may contain as much as 65 to 75 per cent corn. Corn contains a relatively small percentage of non-digestible nutrients as com-

pared to other grains, and it is considered the most economical source of productive energy. Although the cost is greater than for conventional feeds, these high-energy feeds are cheaper when figured on the basis of pounds consumed per dozen eggs produced or pound of weight gained. Soybean oil meal is often used as a source of plant protein. The balance of the ration is usually made up of animal protein, mineral and vitamin supplements, and synthetic amino acids. These mashes may be purchased from most commercial feed mills. The feeding instructions of the company should be followed for best results.

CHART 9

FEED CONSUMPTION TABLE

(Per 100 hens each day)

Percentage of Birds in Production	*Total Feed Consumption*	
	Heavy Breeds	*Leghorns*
50	28-29 lb.	24-25 lb.
60	29-30 lb.	25-26 lb.
70	30-31 lb.	26-27 lb.
80	31-32 lb.	27-28 lb.

Combination Diet. When used by a skilled poultryman, a combination mash and grain diet is a flexible and economical system of feeding. Considerable savings are realized when the grains are grown on the farm or bought at reasonable prices and stored until needed.

The feeding method consists of keeping a 20 to 22 per cent protein mash in front of the birds at all times. In the morning, one-quarter of the total grain allowance is scattered in the litter. The mixture consists of cracked or whole corn, oats, and barley, or combinations of these grains. The number of dirty eggs collected will be reduced by this early morning feeding of grain in the litter. The rest of the grain allowance may be either hopper fed or scattered in the litter during the late afternoon. A supply of insoluble grit should be hopper fed when whole or cracked grains are used. The ratio of grain to mash feedings will vary according to these factors: 1) *Time of year.* Birds need more of the energy-producing grains during cold weather. 2) *Percentage of birds in production.* Flocks laying 60 per cent or better require greater amounts of high-protein mash. 3) *Type of housing.* Birds confined in well-insulated houses require less grain than birds housed in poorly insulated units. 4) *Breed and strain.* Heavy birds require more grain to maintain body weights and meet production needs than Leghorns and other light breeds.

Do not use guesswork in establishing grain levels for the laying flock. The over-all protein level must not fall below 15 per cent. Grain mixtures average 10 per cent protein and laying mashes 20 to 22 per cent. If the birds

are given too much grain, the amount of protein they receive will be insufficient for optimum egg production. Weigh the grain feeding carefully for each pen. The amount of grain should vary according to the weather, the average weight of the birds, and their rate of production. Have five or six birds leg banded from each pen and check their weights at least once a week. Keep day-to-day records on 1) the number of birds in each pen; 2) the number of eggs produced per pen; and 3) the weight of the leg banded birds. Watch for any decrease in mash consumption or loss of body weight. These are warning signs of disease, early molts, and reduced egg production.

Chart 10 summarizes a few sample grain and mash feeding combinations for both light and heavy-weight flocks. We are assuming an average weight for Leghorns of 4 and one-half pounds and 5 and one-half to 6 pounds for heavies. One hundred mature light-weight birds will consume approximately 25 pounds of mash or grain in one day. One hundred heavy hens will utilize 30 pounds of mash or grain per day.

CHART 10

APPROXIMATE GRAIN TO MASH RATIOS

20% Protein Mash (Pounds per 100 birds)	*10% Protein Grain (Pounds per 100 birds)*	*Total Protein Consumed (Mash and Grain) (Percent)*
	Leghorns	
20	5	18.0
19	6	17.6
18	7	17.2
17	8	16.8
16	9	16.4
15	10	16.0
14	11	15.6
13	12	15.2
12½	12½	15.0
12	13	14.8
	Heavies	
25	5	18.3
24	6	18.0
23	7	17.7
22	8	17.3
21	9	17.0
20	10	16.7
19	11	16.3
18	12	16.0
17	13	15.7
16	14	15.3
15	15	15.0

The Free-Choice System. One set of feeding hoppers is filled with a 30 or 35 per cent protein mash and separate hoppers are filled with scratch

grain. These are kept in front of the birds throughout the day. The birds are free to regulate their own diets. Grains may be mixed with a 30 per cent protein mash in the ratio of 2 parts grain to 1 part mash. This particular mixture will provide a 15 per cent protein diet. The free-choice method of grain and mash feeding is not recommended for heavy breed flocks or for high-producing strains of Leghorns, especially during the spring and summer months.

Pellets or Crumbles. Often used to supplement regular grain and mash or all-mash rations, pellets are particularly convenient to use on range where hoppers may be exposed to high winds. They also will stimulate lagging appetities and help maintain a high mash consumption level during hot weather. Flocks suffering from vaccination reactions, respiratory infections, or other weakening conditions will benefit from increased feedings of pellets. They usually are fed at a rate of 5 pounds per day for each 100 birds.

Keep Mash Consumption High. No matter what type of feeding system is used, a high level of protein intake must be maintained. A drop in feed consumption may be the first warning of impending molts, disease outbreaks, or hot weather egg-production slumps. As soon as feed consumption drops or body weights decrease, take the following steps to stimulate feed intake:

1. Fill mash hoppers or mechanical feeders more frequently.
2. Stir the mash that remains in the hopper anytime you enter the pen. This will help stimulate the birds' interest in food.
3. Feed wet mash once or twice a day. A small garden sprinkler may be used to run a trickle of water down the center of the mash hopper. Wet mash may also be prepared by mixing warm water, skimmed milk, or buttermilk with dry mash until the consistency is crumbly. The mixture should barely hold together when squeezed in the palm of the hand, but should not be moist enough for water to be expressed. Cod liver oil may be added to wet mashes that are being fed to birds with colds or respiratory infections.
4. Do not feed more wet mash than will be cleaned up in 20 to 30 minutes. Estimate feedings at a rate of 2 pounds of dry mash per 100 birds. Wet mash that remains at the end of the feeding period should be removed. The mixture will sour and get moldy easily.
5. Bran and molasses may be used in place of wet mash feedings. The mixture is indicated as a tonic and a mild laxative. It is also used in the treatment of pullet disease. *(See Page 165.)*
6. Feed pellets at the rate of 3 to 5 pounds per 100 hens. Birds will eat pellets when they turn their beaks up at regular or wet mash feedings. However, over-feeding may dull a flock's appetite, even for pellets. Do not feed more than the amount stated above, or all the birds will clean up in 20 to 30 minutes.

7. Handle increases in grain feeding carefully. Protein levels must be maintained at 15 per cent *or higher.* Extra grain allowances may be indicated during cold weather. Birds in winter production can utilize the additional sources of energy supplied by the carbohydrate-rich grains.

Medicated Mashes. Growing in popularity during recent years are ready-mixed feeds complete with sulfa drugs, antibiotics, tonics, worm powders, and laxatives. When properly administered, medicated feeds are definitely useful in preventing and treating diseases, as well as hastening recoveries from diseases or vaccination reactions. The manufacturer's directions should be followed *exactly.* Do not combine two or more drugs without the specific recommendation of your veterinarian or poultry pathologist. Obtain an accurate diagnosis of the condition before spending your time and money on medicated feeds and tonics. Learn what disease it is you are treating or trying to prevent before you dispense expensive drugs and medicaments.

No book yet has been written nor any instructions devised that will guarantee success in getting the poultry flock to eat more than they want in sickness or in health. There are days when the simple tapping of the feed hopper will result in full crops. There are other days when feeding each bird with a silver spoon will fail to bring about the desired results. After working with your own flocks under your own farm conditions, you should be able to devise formulas for increasing feed consumption and maintaining sharp appetites. Feeding is an art; an art that results in birds roosting at night with full crops and waking in the morning with renewed appetites. These are the birds that probably will fill the nests rather than the cull coops or disposal pits.

Bulk Purchases. Tank storage of large feed supplies is recommended for flocks of more than 2,000 birds. The feed may be delivered in bulk trucks and placed directly into farm storage tanks. These tanks sell for $200 to $500 depending on their capacity and type of construction. A 2-and-one-half-ton tank is large enough for 2,500 birds if weekly deliveries are made. A 5-ton tank is needed for 5,000 birds. This estimate does not include the additional supplies needed for raising your replacement birds. Feed that is purchased in bulk can be obtained at discounts of $2 to $5 per ton. Other advantages include the savings in time, labor, and storage space. The job of opening, lifting, and emptying sacks also is eliminated; and less effort is required to fill feed carts or mechanical hoppers from strategically placed storage tanks. Outdoor storage of feed supplies is possible with the use of weather resistant tanks. And feed stored in metal tanks is not vulnerable to the maraudings of rats and mice. (*See Plate 13.*)

Sacked Feed. Supplies are delivered in paper, cotton, or burlap sacks. Proper storage methods are necessary to minimize waste due to dampness, spoilage, or rodent destruction. (*See Figures 10, 11, and 12.*) Careful handling of the full as well as the empty sacks will help you realize maximum

returns on their resale. The Burlap Council of America recommends the following measures:

1. The resale value will be greatly increased by careful handling of the empty bag.
2. So, don't open burlap bags with a knife. Slashing reduces resale value and ruins bags for reuse in many handy chores around the farm.
3. Instead, pick the rip cord at the top with an icepick, nail, or pointed instrument and bags will open easily.

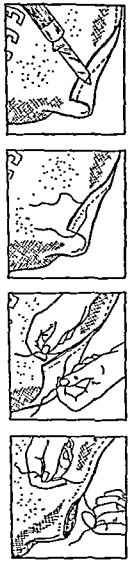

Fig. 10. To open feed bags carefully and easily follow these directions: Don't slash! Carefully cut three or four stitches. Then shake threads loose on both sides of bag. Next, hold ends of both threads. Finally, unravel by pulling straight out, away from bag. (Courtesy of The Burlap Council.)

4. If used to pack grain or other feeds, reverse the bag and shake out well so that rodents won't be attracted by remaining bits of feed.
5. Store bags in one or a few convenient places. This makes collection and counting simple.
6. When burlap bags are *full they can be stacked tightly*, as air will filter through the porous weave and keep the contents fresh. Burlap takes rough handling even with bulky contents, so you can stack it solid and high. Burlap bags can be shifted by slings without fear of damage or breaking.

7. Remember that whether full or empty, burlap bags should be stacked on boards or pallets raised three to six inches off the floor. This protects the bags and contents from moisture. Pile empty bags on pallets or fold over rafters or partitions to keep them dry.

8. Bundle empty burlap bags in batches of 50 to 100. This makes easy storing, counting, and shipping. Ship empties several times a season to clear space and reduce loss from damage. If buyers grade them—this means more profit than a flat price per bag.

9. Keep in touch with the farm supply dealer who gives you cash for empty burlap bags. He will keep you posted on current prices for accumulated bags.

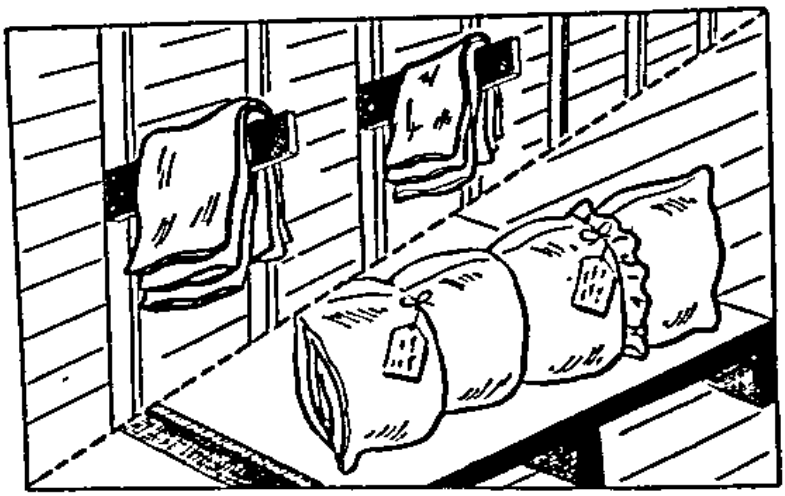

Fig. 11. Careful handling of empty bags increases their salvage value. Hang them from 2" x 4" boards nailed to the barn uprights. Bundles of 50 or 100 bags should be stored on raised pallets until they are sold. Bags thrown carelessly into a corner of the feed room attract rats and mice. (Courtesy of The Burlap Council.)

10. Plan ahead and get most value for your empty bags. Resale value is higher for mill feed bags than fertilizer bags. It's a good idea to keep them separate. Fertilizer bags can always be turned inside out and put to extra use in field collection of your crops.

11. When bags no longer have good resale value they can be used for many handy chores around the farm. They can help you screen poultry houses, wrap shrubbery, carry seed, pick fruit, and do a hundred other pinch-hit jobs that mean economy on the farm.

12. Sell your bags to reliable used bag dealers—they give you more than occasional bag collectors.

Rodent Control. Rats and mice have hearty appetites. They may consume up to $25 worth of feed for every 100 hens you raise. Rodents also carry disease from farm to farm and succeed in frightening young broods into costly pile-ups. It pays to guard against rats and mice in the feed room, as well as in other farm buildings. A rat control program for the farm is discussed on Page 133.

FEEDING SUGGESTIONS FOR LAYING FLOCKS

Mash: Fill hoppers in the morning. Let the supply get low before the next scheduled feeding. Scrape the old mash to one side and fill the hopper with fresh feed. Then mix the leftover mash in and over the new feed. Always keep fresh mash in front of the birds. Stir the mash in the hoppers whenever you go into the pens to keep up the birds' interest in food. Feed waste can be cut down if hoppers are filled to two-thirds capacity.

Grain: Never feed more than 10 to 12 pounds of grain daily per 100 hens. High-producing flocks should receive no more than 10 pounds. Pro-

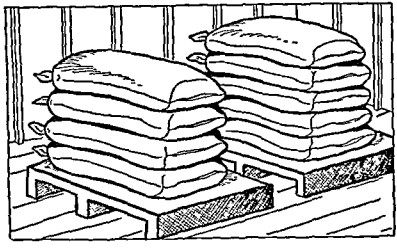

Fig. 12. Careful storing of feed bags on raised pallets assures proper ventilation and minimizes losses from dampness, flooding, or sweating floors. Improperly stacked feed supplies also offer both food and shelter for rats and mice. (Courtesy of The Burlap Council.)

tein levels must be kept at 15 per cent and higher. (*See Chart 10.*) An early morning feeding of scratch grain in the litter will help keep the litter dry. Feed only as much grain as the birds will finish in 20 to 30 minutes. During cold weather or when the birds start losing weight, feedings should be increased.

Water: Clean out the water fountains at least twice a day. If the water is fresh and clean it does not need to be disinfected. Detergents, chlorine solutions, potassium permanganate, and other disinfectants lose most of their efficiency in the presence of dirt or fecal matter.

Pellets: Feedings of pellets are indicated when appetites lag, whether from cold or warm weather, colds, vaccination reactions, or when birds are suffering from disease. Feed pellets at noon, allowing 3 to 5 pounds per 100 hens. Do not feed more than the birds will clean up in 20 to 30 minutes.

Oyster shell: Refill hoppers every other week. The birds must have constant access to shell. Approximately 2 and one-half pounds of shell will be eaten for every 200 eggs produced. Shell may also be mixed with all-mash rations and placed in the regular feed hoppers.

Grit: Refill hoppers as needed. The grit may be scattered on top of the mash every four weeks. Grit is not required if the birds are on an all-mash diet.

Green feed: If suitable range products are fed to replacement pullets, sizeable feed savings are possible. However, green feed should be fed to laying flocks in limited quantities. Limit the daily feedings to no more than five pounds per 100 birds. A greater amount may cause the egg yolks to be dark in color.

Reduced Feed Costs. Decreasing the cost of rations is possible if the right sized feed hoppers are used or the mechanical feeders are adjusted to the proper height. Feed only those birds in production. Cull rigidly and regularly, removing marginal and non-producing birds. Figure your feed costs not on the basis of the price per ton, but on the basis of the cost of rations per dozen eggs produced.

HIGH ENERGY LAYING MASH FORMULA

	Pounds
Ground yellow corn	612
Standard wheat middlings	175
Soybean oil meal	100
50 per cent meat scrap	50
60 per cent fish meal	20
Alfalfa leaf meal	25
Butyl fermentation products (Riboflavin)	10
Steamed bonemeal	20
Ground limestone	30
Salt	5
Vitamins A and D, feeding oil	2.5
Vitamin B_{12} concentrate	1
Manganese sulfate	⅛
Nicotinic acid	10 grams

Chapter 13

ARTIFICIAL LIGHTING FOR MAXIMUM EGG PRODUCTION

HENS MUST HAVE 14 HOURS OF LIGHT, EITHER natural or artificial, to sustain a profitable rate of egg production. During the spring and summer, the long days provide light enough for maximum stimulation of the reproductive processes. The enterprising poultryman wants his flock to lay well the year around. To achieve this goal, he must use artificial lights during the fall and winter to supply a minimum light day of 14 hours.

How Lights Stimulate Egg Production. The reproductive cycle in fowl is initiated and controlled by body chemicals known as hormones. The principal hormone responsible for egg development is produced by the pituitary or "master" gland, which is located at the base of the brain. The pituitary is activated by light rays that reach it through the nerves of the eye and surrounding tissues. The less light there is the fewer hormones are secreted by the pituitary. Egg production decreases as a result. Artificial illumination is needed during the fall and winter months when the natural day provides less than 14 hours of light. Most lighting systems are turned on in mid-September and kept in use until the first or second week of April. The lights may be turned on earlier in the fall to help bring late hatched pullets into production. They may also be used during the late summer months to prevent premature molting of early hatched pullets.

The use of artificial lighting *will not* increase the total number of eggs a bird is capable of laying. They *will* stimulate a bird's inherited "rate of production" during those months when egg prices are most favorable. Maximum production during the fall and winter will contribute materially to a high level of poultry profits.

Morning lights: In the fall, begin by having the lights switched on about 30 minutes before sunrise and leave them burning until daybreak. After the first week, set them back another 30 minutes. Continue this procedure until the artificial day begins at 3:00 A.M. When the days are rainy or overcast, the lights may be left on for a longer time. Discontinue artificial light-

ing in the spring when 13 or 14 hours of natural daylight again occur. Time schedules for sunrise and sunset may be obtained from local newspapers, *The Farmer's Almanac*, or *The World Almanac*.

Evening lights: These may be used exclusively, but they offer no advantage over the other systems described. They are turned on just before dusk and continued until a 14 hour day has been provided.

For flocks that show signs of premature molting, all-night lights may be indicated during the summer months. Once started, however, all-night lights must be continued until the completion of the egg production cycle. Disruption of the night lights may throw the flock into a full body molt with a complete halt of egg production.

The use of both morning *and* evening lights provides a uniform working day in which more equal distribution of chore time is possible. The morning lights are usually started at 4:00 A.M. and left on until sunrise. They are used again from dusk until 6:00 P.M. Instead of cutting the lights off abruptly at night, dim them gradually to simulate normal conditions. When the birds have found their way back to the roosts and have settled down for the night, the lights are switched off. If a dimmer circuit is not available, 10 or 15-watt bulbs may be placed on separate switches and allowed to burn throughout the night.

Red lights: May be used to stimulate egg production. During the war years, because of the dim-out and black-out restrictions, red bulbs were used and proved satisfactory in tests conducted by the New Jersey State College of Agriculture. Eight hours of light were provided by the red, 10-watt bulbs installed 1 and one-half feet over the perches. All sections of the roosting area were at least within 3 feet of a lamp. The eight-hour exposure was deemed equivalent to the stimulation of four hours of white light from 40- or 60-watt bulbs.

Never Vary Lighting Systems Abruptly. Make lighting changes of no more than 30 minutes a week. Sudden changes may throw the flock into premature molting. Automatic time switches may be made by welding some Number 9 wire to the alarm handle of an inexpensive clock. Other automatic switches may be purchased and installed at a reasonable cost. (*See Plate 14.*)

An early start of the day's laying activity may lead to an overcrowding of the nesting facilities. This condition may be partially relieved by adding extra nests and scheduling the first of the day's egg collections between 7:00 A.M. and 8:00 A.M.

How Much Light Per Pen? One 40 or 60-watt bulb per 200 square feet of floor space is satisfactory under most conditions. The reflectors should be about 4 inches deep and 16 inches in diameter. Roosts, feed hoppers, and water fountains should be well illuminated. Avoid having deep shadows in any part of the pen. Place fixtures so they are 5 to 6 feet from the floor. Place lights no more than 10 feet apart. If 100-watt bulbs are used, the

distance may be increased to 15 feet. Fluorescent units may be used instead of incandescent bulbs. The savings in electricity compensate for the relatively high cost of installation.

A short-time exposure to brilliant light will also effectively stimulate fall and winter egg production. A 1,500-watt bulb flashed on for 15 seconds a day will supply the necessary stimulus to the reproductive system. Birds need not consume feed during the hours they receive the artificial light. They will eat enough mash, pellets, and grain during the day to sustain the increased production of eggs.

Remember these points about lighting:

1. Provide one 40- or 60-watt bulb for every 200 square feet of floor space.
2. Test the lights during the day. Replace burned out bulbs at this time.
3. Keep bulbs and reflectors free of dust and dirt.
4. Be prepared to start lights in mid-September. Allow a minimum light day of 14 hours. Continue lights through the first or second week of April.
5. Never change the lighting schedule abruptly. Increase or decrease artificial lighting not more than 30 minutes a week.
6. If all-night lights are used, continue them until the flock is sold or is purposely thrown into a molt prior to the breeding season.
7. Keep feed hoppers filled. Stimulation of fall and winter egg production throws an extra burden on the bird's reproductive and digestive system; thus, an increase in food consumption with wet mash or pellets is needed. Be sure the birds always have plenty of fresh water. Keep the water from freezing in the winter with heating cable or similar devices.

Chapter 14

THE PRODUCTION AND MARKETING OF QUALITY EGGS

WHAT DETERMINES EGG QUALITY?

STANDARDS OF EGG GRADING ARE BASED ON four factors: (1) The shape and condition of the *shell,* (2) the size and degree of movement of the *air cell,* (3) the condition and appearance of the *albumen, or egg white,* and (4) the condition and appearance of the *yolk.* These factors are influenced by a bird's heredity, diet, environment, your management of the laying flock before and during egg production, and the care with which you handle the eggs produced.

Egg Candling. Egg graders cannot open each egg to examine the condition of the yolk or white. But through the process known as *egg candling,* trained personnel can determine, with reasonable accuracy, the interior quality of an egg. Candling provides information about the condition of the egg shell, the relative size and movement of the air cell, and the condition of the yolk and white of the egg. The candler also is able to detect foreign bodies or defects that may be present in the yolk or white of an egg.

The process of candling consists of holding the large end of an egg in front of a small aperture through which a beam of white light is passed. The United States Department of Agriculture recommends the use of a lamp that projects 350 to 450-foot candles of light. The egg is held between the thumb and tips of the first two fingers and given a slight twist as it is placed in front of the candling light. The inner contents of the egg will rotate as they cast their shadow against the shell of the egg. The density of the shadow and the comparative freedom of movement it shows are used in determining the grade of the egg. The entire surface of the egg should be viewed to detect any unsoundness in the structure of the shell or evidence of internal defects.

Quality of the Shell. An egg graded "AA" or "A" has a shell that is clean, sound, and normal in shape. The grade "B" egg has a clean and sound shell that may be slightly irregular in shape. The grade "C" egg may have an abnormally shaped shell but must still be clean and sound. Dirty or

cracked eggs may not be included in these four top grades. Such eggs often are sold directly to the retail trade at discount prices, or they are broken out and sold to local bakeries, restaurants, or candy shops.

Uniformity in the color of the egg shell is not an important grading factor, but it is nevertheless considered by the purchasing housewife. It is naturally of most concern to the producer of brown eggs.

United States Standards for Quality of Individual Shell Eggs

AA Quality: The shell must be clean, unbroken, and practically normal. The air cell must not exceed one-eighth of an inch in depth and be practically regular. The white must be clear and firm so that the yolk appears well centered and its outline only slightly defined when the egg is twirled before the candling light. The yolk must be free from apparent defects. (*See Plate 16a.*)

A Quality: The shell must be clean, unbroken, and practically normal. The air cell must not exceed two-eighths of an inch in depth and must be practically regular. The white must be clear and at least reasonably firm so that the yolk appears at least fairly well centered and its outline only fairly well defined when the egg is twirled before the candling light. The yolk must be practically free from apparent defects. (*See Plate 16b.*)

B Quality: The shell must be unbroken and may be slightly abnormal and may show slight stains but no adhering dirt, provided that they do not appreciably detract from the appearance of the egg. When the stain is localized, approximately 1/32 of the shell surface may be slightly stained and when the slightly stained areas are scattered, approximately 1/16 of the shell surface may be slightly stained. The air cell must not exceed ⅜ inch in depth, may show unlimited movement, and may be free but not bubbly. The white must be clear and may be slightly weak so that the yolk may appear off-center, with its outline well defined when the egg is twirled before the candling light. The yolk may appear slightly enlarged or slightly flattened and may show other definite, but not serious, defects. (*See Plate 16c.*)

C Quality: The shell must be unbroken and may be abnormal and may have slight to moderate stained areas covering not more than one-quarter of the shell surface but no adhering dirt. Prominent stains are not permitted. The air cell may be over ⅜ inch in depth and be free or bubbly. The white may be weak or watery so that the yolk may appear off-center and its outline plainly visible when the egg is twirled before the candling light. The yolk may appear dark, enlarged, and flattened, and may show clearly visible germ development, but no blood due to such development. It may show other serious defects that do not render the egg inedible. Small blood clots or spots may be present. (*See Plate 16d.*)

Dirty: The shell must be unbroken, and it has adhering dirt or prominent stains, or slight to moderate stains covering more than one-quarter of the shell surface.

Check: An individual egg that has a broken shell or crack in the shell but with its shell membranes intact and its contents do not leak.

Leaker: An individual egg that has a crack or break in the shell and shell membranes to the extent that the egg contents are exuding or free to exude through the shell. An egg which has a portion of the shell missing (in excess

of an area one-quarter inch square) is considered a leaker even though the shell membrane is intact.

Thin shells may be caused by:

1. *Season and temperature.* Thin-shelled eggs are more prevalent during warm weather. At the end of their laying season, hens will lay eggs with thinner shells.
2. *Heredity.* The tendency to lay thin-shelled eggs can be transmitted from hens to their offspring.
3. *Feeding.* Lack of Vitamin D, calcium, phosphorus, and other minerals will affect shell quality.
4. *Age.* Older birds lay more thin-shelled eggs than pullets.
5. *Disease.* Some birds recovering from Newcastle disease or bronchitis lay eggs with thin shells.

Quality of the Air Cell. During an egg's passage through the hen's oviduct it is enveloped by two tissue-like coatings called the inner and outer shell membranes. When the egg is first laid, there is no visible separation between these two membranes. But as the egg begins to cool and lose some of its moisture there is a shrinking of the inner contents of the egg. This causes the two membranes to pull apart, forming what is known as the *air cell.* The air cell usually is found at the large end of the egg.

The relative size and degree of movement of the air cell offer reliable information as to the kind of care an egg has received after being laid. The air cell of an "AA" quality egg measures one-eighth of an inch or less in depth and remains in a more or less fixed position. An enlarged air cell suggests that the egg has been exposed to high temperatures or dry air. Bubbles in the air cell, or a cell that moves freely from one end of the egg to the other, indicate that the egg has been jarred or handled roughly. Small air cells, on the other hand, are found when the eggs have been gathered frequently, cooled rapidly, and properly kept in a room with a low temperature and high humidity.

Quality of Egg White. The white of an egg is made up of four layers deposited around the egg during its passage through the oviduct. For practical purposes, however, only two layers need be mentioned. They are the thick, firm white immediately surrounding the yolk, and the thinner layer of white that spreads out beyond this point. (*See Plate 15.*) When the egg is broken, two cord-like strands of albumen are visible at either end of the yolk. These are called the *chalazae.* The primary purpose of the chalazae and the thick white is to help keep the yolk centered in the shell. If eggs are stored under warm, dry conditions, the protein fibers of the thick white will begin to break down. Eventually, the thick and thin white will run together and appear flat and watery when the egg is broken out. The yolk will also flatten out, in marked contrast to the firm, round yolk of a top-grade egg.

The condition of the white of an unopened egg may be approximated by

the freedom of movement and the relative darkness of the shadow cast by the yolk when viewed before the candle. Occasionally, the inexperienced candler may mistake the shadow of the chalazae with that of a meat spot or clot of blood. There is a distinctive difference between the two. The chalazae, being somewhat translucent, cast a faint shadow with a halo-like effect. Meat spots or blood clots are rather dense and opaque and cast dark, distinct shadows.

Watery whites may be caused by:

1. *Season and temperature.* Temperatures above 90 degrees will cause an increased number of eggs to have watery whites.

2. *Heredity.* The tendency to lay eggs with low-quality whites can be passed from a hen to her offspring.

3. *Disease.* Eggs with thin and watery whites may be laid by birds recovering from Newcastle disease or bronchitis.

4. *Storage conditions.* The internal quality of eggs stored at high temperatures and low humidity will deteriorate rapidly.

Judging the Quality of the Yolk. Housewives are most critical of the appearance and condition of the yolk of an egg. They prefer a yolk that is light and uniform in color, that is free of such defects as blood or meat spots, and that stands firm above a surrounding layer of thick white. When a fresh, high quality egg is being candled, the yolk will be well-centered and will cast a faint shadow and show limited freedom of movement. A poorer quality egg will cast a darker, more clearly defined shadow that moves more freely when the egg is twirled. This results from the egg white's becoming thinner and less able to hold the yolk firmly in place, the yolk then rising closer to the shell. The characteristics of a top-grade egg that has been broken out are shown in Plate 16a.

Germ Development. All eggs, fertile or infertile, have a small white spot on the top and to one side of the yolk. This is known as the germ spot or germinal disc. This spot consists of living cells, which, *if the egg becomes fertilized,* will develop into the growing chick embryo. A small, irregularly shaped germ spot means either that the egg is infertile, or that it has been cooled quickly to prevent development of the germ. A chick embryo will start to grow at temperatures over 70 degrees F. Fertile eggs should be cooled quickly to 55 or 60 degrees F.

Male birds are not necessary to the production of eggs. Despite what our urban cousins may believe, hens will lay their normal quota of market eggs with or without the presence of roosters. (Male birds should be marketed at an early age unless you plan to incubate your own eggs or sell fertile eggs to local hatcheries. Cockerels from straight-run broods may be finished off as broilers or fryers, or kept for fattening as capons.) Males are required only for the production of fertile eggs to be used for hatching baby chicks. If roosters are allowed to run with laying flocks, all the eggs produced must

be refrigerated within a few hours of the time they are laid. If left at room temperatures or in a warm nest, the cells in the germ spot commence to grow and visible blood vessels will form around the top of the yolk. If the egg is cooled *after* germination has started, the blood vessels will disintegrate and discharge their contents into the body of the egg. The freed blood accumulates in a circle on the surface of the yolk. This is called a *blood ring.* Such eggs are classed as inedible. If germ development is clearly visible but has not reached the blood ring stage, the egg automatically drops to a "C" quality grade.

COMMON EGG DEFECTS

Blood Spots. Two to 4 per cent of all eggs laid have a small particle of clotted blood on the surface of the yolk or white. These blood clots are detected on candling by the dark shadow they cast. Blood clots are thought to be caused at the time of ovulation by a rupture of small blood vessels as the yolk passes from its enclosing membranes. Under normal circumstances the yolk passes along a small, blood-free line known as the stigma. Should the rupture of the membranes occur in an area other than the stigma, a small amount of blood may be freed which then accompanies the egg through the various stages of its development. Eggs with large blood spots are considered inedible products.

When young pullets first start heavy production, they may lay a high percentage of blood-spotted eggs. This phase, however, is usually of short duration, with normal production returning shortly. *Fright may cause blood clots!* It is believed that if birds are handled roughly or are frightened at the height of their laying cycles, they may ovulate prematurely or the egg membranes may rupture in an area having many blood vessels. Laying birds are delicate creatures. Avoid making sudden moves or loud noises. Announce your approach to a pen by knocking on the door or whistling. Be sure all laying house windows are screened to keep out sparrows and other birds or animals. Keep up a rigid rat control program.

The tendency to lay eggs with blood spots is often transmitted from one generation to another. Selective breeding makes it possible to obtain birds that will produce a high percentage of quality eggs. Always purchase your baby chicks from reliable sources.

Meat Spots. These are actually clots of blood that have undergone certain degenerative changes during the passing of the egg through the oviduct. The pigmentation of the so-called meat spots has a tendency to be darker in brown eggs than in white eggs. Light-colored spots may go undetected during candling or when the egg is broken out. Unsightly, large meat spots place an egg in the inedible class. Again, purchasing replacement chicks from breeding flocks producing high quality eggs, and gentle handling of your flocks will help cut down the number of defective eggs produced.

Dark Yolks. *The type of feed a bird gets can influence yolk color.* Too much green feed or yellow corn, both relatively high in carotene content, will cause birds to lay eggs with deep yellow or orange yolks. Birds that are fed mashes containing a high percentage of cottonseed oil meal and birds that eat the seeds of cheeseweed or hollyhock will lay eggs with dark, greenish yolks. The off-color may not appear until the eggs have been kept in cold storage for a while. If the birds have eaten onions, cabbage, turnips, and similar plants, their eggs will have an objectionable odor.

Double Yolks. Eggs with two or more complete yolks result from an upset in the bird's normal reproductive process. A relatively immature yolk may occasionally be passed at the same time, or closely following, the normal ovulation of a mature yolk. The two ova then are caught up by the infundibulum or funnel of the oviduct and pass through the oviduct. Tumors or other obstructions in the oviduct also may cause the laying of double-yolked eggs.

Large, oversized eggs, in spite of the premium prices they bring, present a marketing problem. Because of their size, extra precautions must be taken for shipment to market. Two egg flats with the cups facing in opposite directions should be placed on top of the case to provide ample protection in transit. If wooden cases are used, the two egg flats may be used and the sides of the case built up with small wooden strips before the lid is nailed. If the flock is producing only a few dozen double-yolkers a week, it is advantageous to package and sell them to local retail outlets.

Stuck Yolks. The yolks of a small percentage of cold storage eggs may rise and stick to the top of the inner shell membrane. The condition most often is encountered in low-quality eggs or eggs that have been stored improperly. The occurrence of stuck yolks can be prevented by maintaining correct storage conditions and by placing in cold storage only those eggs that are reasonably high in interior quality. Eggs with stuck yolks are classed as inedible products.

FACTORS INVOLVED IN EGG QUALITY

Heredity. Some birds will produce small, soft-shelled or misshapen eggs regardless of the care they receive or the feed they consume. Layers that produce these eggs most probably transmit the trait to their offspring. Eggs for hatching should be saved only from hens that lay sound, large-sized, normally shaped eggs. The tendency to lay eggs with clear, firm whites also may be passed from a hen to her progeny. Wherever practical, poultry breeders are careful to eliminate from the breeding flock those birds consistently producing eggs with loose and watery whites. Replacement stock should be purchased from breeding flocks that have proven records of quality production.

Nutrition. The condition and kind of feed you give the birds of your lay-

ing flock will have a definite influence on the quantity and quality of the eggs they produce. Hens laying at full capacity must have wholesome, well-balanced rations to maintain health and continue the reproductive process. In addition to regular all-mash or mash and grain feedings, they must have liberal supplies of oyster shell or other sources of calcium. A shortage of calcium is reflected in the production of small, soft-shelled, or misshapen eggs.

Weather. Hot weather has an undesirable effect on the quality of egg white, shell texture, and the size and number of eggs laid. Be prepared to supplement the birds' regular diet with wet mashes and pellet feedings at the first signs of rising temperatures. Sprays, sprinklers, foggers, light-colored or aluminum roofs, and forced draft ventilation systems will help prevent mortality and egg production losses. June through December are the most profitable egg producing months. Proper care of the flock in the summer and early fall is of the utmost importance in obtaining maximum profits.

Disease. Various diseases and parasitic conditions may interfere seriously with egg production. Newcastle disease and bronchitis are particularly damaging, and an outbreak of either disease could cause a marked drop or even a complete cessation of egg production. When recovered birds resume production, they will lay many soft-shelled and abnormally shaped eggs. Their eggs may have loose, watery whites. Some hens will become internal layers after an attack of bronchitis. The production of low-quality eggs after a disease outbreak may be a factor in deciding whether to depopulate or nurse a sick flock back to health. (*See Page 168.*) *Avoid late vaccination against Newcastle disease and bronchitis.* The live Newcastle or bronchitis viruses may seriously interfere with the onset of egg production when introduced to a ready-to-lay flock. Be sure to complete all vaccinations at least one month before the flock is due to start laying.

Management. You cannot improve an egg once it has been laid. However, you can *preserve the quality* of that egg until it is marketed. A large part of your chore time will be spent in collecting, cooling, cleaning, grading, and packing eggs. The following practices are recommended to help preserve the quality of fresh eggs:

1. Gather eggs frequently. The internal temperature of a newly laid egg is 104 degrees F. The temperature in the nest may be 100 degrees or more. Unless the eggs are removed promptly from the warm nests and placed in a cool, humid atmosphere, their quality will drop rapidly. Don't leave eggs in the nests for more than two or three hours. Gather the eggs often—at least three times a day during normal weather and more often on very warm or cold days.

2. Cool eggs rapidly to preserve freshness. To prevent a loss in quality, eggs must be cooled to 55 or 60 degrees within six hours of the time they are laid. Cooling may be accomplished in specially constructed egg rooms, re-

frigerators, cellars, or evaporative coolers or cabinets. Until they are marketed, the eggs should be stored at temperatures ranging from 50 to 60 degrees F. with a relative humidity of 75 to 85 per cent. Do not rely on guesswork in regulating temperatures and humidity; install and check thermometers and humidity indicators. Automatic humidifiers and thermostatic controls are recommended for accurate regulation of egg room conditions.

3. Use wire baskets. Eggs placed in wire baskets, which permit a free circulation of air, will cool to 50 to 60 degrees in approximately *five hours*. When exposed to a forced movement of cool air in evaporative coolers or refrigerated egg rooms, they will reach the desired internal temperature in *one hour*. Eggs stored in solid pails require *at least eight hours* to cool, and it takes *15 hours* when the eggs are packed directly into the egg cases. (*See Plate 17.*)

4. Market eggs at least twice a week. Egg rooms and storage facilities should be large enough to hold at least three days' production. The eggs should be marketed not later than three or four days after they have been laid. Space must be provided for the storage of an adequate supply of empty cases, fillers, and flats.

5. Pack eggs in pre-cooled cases. One day's supply of egg cases, fillers, and flats should be placed in a cool damp room at least 24 hours before they are to be used. Eggs put in conditioned cases are less apt to suffer moisture loss than those packed in warm, dry cases.

6. Pack eggs large end up. When eggs are packed with the small end placed upward, there is a marked tendency for the yolks to rise to the point of the egg. Also, the air cell located at the large end of the egg may become somewhat loose or free moving. Repeated tests conducted at agricultural experiment stations show that cases packed with a high percentage of "upside-down eggs" will grade lower than cases properly packed with "Large End Up!"

7. Protect your shipments of eggs. United States Department of Agriculture marketing specialists advise poultry producers to:

a. Keep supplies of 3-inch paper tape and three-penny, large-headed, cement-coated nails on hand for use in repairing fiber and wooden egg cases.

b. Repair broken cases promptly.

c. Use second-hand cases to deliver eggs from producers to receivers, or to ship eggs short distances.

d. Store, in a relatively cool, dry atmosphere, cases not needed for immediate use.

e. Keep fiber and wooden egg cases separated.

f. Remove tops from wooden cases carefully to avoid splitting them.

g. Use only clean cases, flats, and fillers.

h. Grade eggs for uniformity in size.

i. Pack eggs with large end up. Pack large eggs, "cracks," or "checks" separately.* Extra large eggs for shipment should be packed 18 eggs to the filler. (The standard filler holds 36 eggs.)

MARKET SOUND, CLEAN EGGS

The following management suggestions will help assure the production and marketing of sound and clean eggs:

1. Provide enough nesting space. Overcrowded nests are not conducive to the production of clean, unbroken eggs. One box-type nest should be available for every five hens. If community nests are used, allow 1 square foot for every five hens. The Massachusetts "clean egg nest" shown in Figure 13 has proved satisfactory on many farms. Wire-bottom, roll-away nests may be farm-built or purchased from poultry supply houses.

2. Keep nests dark and cool. This will discourage feather picking, egg eating, pickouts, and other troublesome vices. During the summer months, the cool nests will prevent many deaths from heat prostration. (*See Page 187.*) The nests should be examined at regular intervals for evidence of lice or mites. If they go unchecked, these pests may seriously affect the health and productivity of the laying flock.

3. Keep the nests clean and dry. Nests should be deep enough to hold plenty of clean, absorbent, and odorless nesting material. Wood shavings, dried sugar cane, and wood-wool excelsior pads are among the more acceptable materials. Chopped hay and straw may be used, but should be changed frequently. Keep a reserve supply of clean nesting material in each laying pen. Make certain that the nests are filled and clean at all times.

One method of getting the hens to clean their feet before they enter the nest consists of filling a small rectangular tray or box with ground limestone or a similar material. The box is placed on the perch directly in front of the entrance to the community-type nest. As the birds walk through the container, the excess dirt and moisture on their feet is removed.

Discourage the use of the nests as roosts during the night. Close the nests shortly before dark, removing hens that happen to be in them. The nests may be reopened after dark or early the next morning.

Wire-bottom nests or laying cages must be brushed free of dust and droppings at frequent intervals. Most of the waste can be removed by running two stiff-bristle brushes across the upper and lower surfaces of the cages or wire nests.

4. Gather the eggs often. Too few or poorly scheduled collections are often the reasons for having a high percentage of dirty, cracked, and low-quality eggs. Plan a minimum of three pickups a day. During warm weather

* Wherever possible it is advisable to sell "cracks," "checks," and "leakers" to local retail outlets. Badly cracked eggs may be broken out and sold to nearby bakers or candy manufacturers.

and on extremely cold days, gather the eggs four times a day to prevent excessive evaporation or freezing of the eggs. A recommended schedule for gathering eggs is 8:00 A.M., 11:00 A.M., 2:00 P.M., and again at 4:00 P.M. Particular emphasis should be placed on the early morning pickups. The greatest number of eggs laid will be in the nests before 12:00 noon.

5. Don't overload egg baskets. Keep the loads light and easy to manage. Use baskets with a capacity of not more than 12 dozen eggs and handle the collections carefully. Overloading or rough handling will mean added losses from cracking. Eggs laid in warm weather or near the end of the laying season usually have thinner shells than eggs laid during the rest of the year, and thus require extra care.

6. Screen roosts! Keep litter dry! If birds are forced to walk through unscreened droppings or filthy, wet litter, most of their eggs are going to be stained and dirty. Keep at least 6 inches of a reasonably dry litter on the floor, not only to get cleaner eggs, but also to protect the flock against filth-borne diseases. Stir the litter daily and remove wet litter caused by spillage from water pans or fountains. Add fresh litter if necessary. A few extra minutes a day spent in maintaining dry litter may save you many hours of cleaning and washing eggs.

7. Maintain a high pullet-to-hen ratio. Young pullets during their first laying season will produce more high-quality eggs than in their second and subsequent years. Older birds are more inclined than pullets to lay eggs with comparatively thin shells. Older birds also may lay smaller, thin-shelled eggs at the onset of warm weather. For these and other reasons (which are discussed on Page 108) keep a predominantly pullet flock on the commercial egg farm.

THE PROBLEM OF DIRTY EGGS

In spite of your efforts to maintain sanitary conditions in the laying house, 10 per cent or more of the eggs you gather will be soiled. To improve the salability of these eggs, they must be cleaned promptly and carefully before they are packed and shipped to market. The handling of dirty eggs has always been a problem to the farmer and other members of the poultry industry. Lower prices are paid by wholesale and retail buyers for dirty eggs. And those eggs that have been cleaned carelessly are apt to spoil in storage. In many areas, premium prices are paid for clean, *unwashed* eggs.

When it is first laid, an egg is relatively free of bacteria. Nature also provides a protective coat formed by a mucus-like substance that fills the pores of the newly laid egg. This cuticle, as it is called, offers adequate protection against the entry of bacteria. However, its effectiveness is reduced or destroyed under the following conditions:

1. If the egg is covered with dirt or excrement. There are countless numbers of bacteria present in the waste or feces found on dirty eggs. In the

presence of moisture, the bacteria may penetrate the shell and membranes of the egg. The organisms feed and multiply on the inner contents of the egg, with spoilage and rotting the end results.

2. If careless cleaning methods have been used. Washing or excessive dry cleaning destroys most of an egg's protective cuticle. If wash or rinse waters are heavily contaminated or if moisture is present on the surface of an egg, the chances of bacterial spoilage are increased.

3. If wash or rinse waters are colder than the interior of the eggs. The contents of a warm egg will contract when placed in cold or lukewarm water. This will cause a suction action that will draw polluted waters through the open pores and membranes.

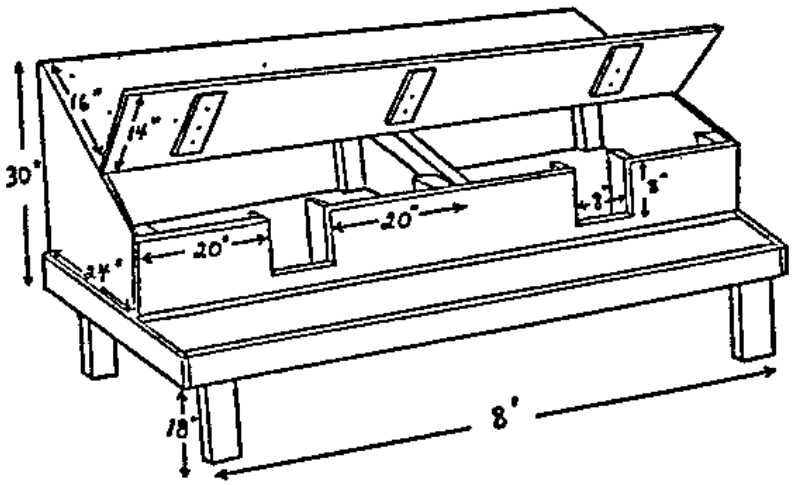

Fig. 13. Community-type nests are easy and inexpensive to build. The deep, dark nests are effective labor-saving devices and also help reduce the number of dirty and broken eggs. The hinged roof opens up to facilitate the gathering of eggs.

4. If eggs are not dried before they are packed. The packing of washed eggs in dirty or moist cases, fillers, and flats will result in an increased percentage of spoiled or rotten eggs.

Cleaning the Eggs. Successful washing is dependent upon (1) a plentiful supply of thermostatically controlled hot water for washing and rinsing, (2) an effective detergent to facilitate the removal of dirt, (3) a sanitizer or germicidal agent to destroy the bacteria washed from the shell, and (4) a device to help with the rapid drying of the eggs before they are packed. In planning your program of handling eggs, keep these suggestions in mind:

Wash only dirty eggs: Do not place dirty and clean eggs in the same baskets. Separating them in the laying house will save time and also reduce the number of dirty eggs. Slightly soiled eggs may be cleaned easily with a sandpaper or emery cloth buffer-brush or a motor-operated buffing disc. If

more than 20 per cent of the surface of the egg is soiled, a wet method of cleaning is recommended.

Wash dirty eggs promptly: The longer the period of time that dirt is in contact with the shell, the greater is the danger of contamination. Clean eggs as soon as possible after they have been cooled. To prevent condensation or "sweating" of the eggs, keep the workroom cool yet comfortable to work in.

Use an approved detergent-sanitizer: *Effective egg-washing compounds* contain a detergent or wetting agent (similar to household soap substitutes) and a sanitizer or germicide, usually quaternary ammonium compound. Select a product best suited to the type of water prevalent in your community. Varying degrees of water hardness will interfere with the effective action of certain sanitizing agents. The use of soap in conjunction with detergents is not recommended. A list of effective detergent-sanitizers may be obtained by writing to The Northeastern Poultry Producers Council, 11 West Street, Trenton, New Jersey.

Keep wash and rinse waters hot: Wash and rinse water must be kept at temperatures higher than the internal temperature of the eggs being washed. The warm water will cause the expansion of the contents of an egg, the increased pressure thus helping to keep bacteria-laden water from entering the egg. Recommended temperatures for washing and rinsing range from 110 to 130 degrees F. *Eggs should be immersed for not longer than three minutes.* Washing machines with spraying units can and should use hotter water. Follow the manufacturer's operating instructions at all times. Extreme care must be exercised if the temperature of the water is greater than 140 degrees F. The white of an egg will coagulate if subjected to such hot water for more than 30 *seconds.* Small water heaters may be installed in the egg room to assure a plentiful supply of hot water. Thermostatic controls are advisable to keep the temperature uniform. The final, warm water rinse should remove most of the detergent residue. Some poultrymen find that the addition of small amounts of chlorine in the rinse water will help in sanitizing the surface of the egg.

Change wash solutions often: Detergents and sanitizers may lose their effectiveness after three or four baskets of eggs have been washed. When the washing solution no longer removes the dirt easily, drain the washing unit, rinse it with clear water, and prepare a fresh mixture of detergent-sanitizer. If there is any doubt about the effectiveness of a solution, discard it at once. Do not chance contamination of an entire basket of eggs.

Dry eggs thoroughly before packing: Washed eggs should be dried immediately after their last rinse. An effective method is to place the basket of eggs in front of an electric hot air dryer or fan. Pack the dried eggs in clean, precooled cases. Packing of moist eggs or the use of dirty fillers or flats may cause excessive spoilage.

Mark cases containing washed eggs: Washed eggs are poor storage risks,

If they are marked so the egg buyer can identify them, he will plan for their immediate use or sale.

Take care of your equipment: After each washing operation, drain, wash, and rinse all equipment with clean water. Then dry it thoroughly. A sanitizing rinse of a quaternary ammonium compound or hypochlorite solution may be used. Bacteria cannot multiply without moisture, so keep your equipment dry. Always check the temperature of the water and the accuracy of the thermostat before you begin the operation. The accidental use of cold or lukewarm water may seriously impair the internal quality of the eggs.

An alternate washing method:

1. Add 1 tablespoonful of detergent to each gallon of water used.
2. Wet the eggs using the detergent solution heated to 140 degrees F.
3. Dip the basket of eggs in a container filled with water heated to 160 degrees F. *for not longer than 30 seconds.* (Discard the solution after it has been used for three baskets of eggs.)
4. Let the eggs drain for two or three minutes. Step three may be repeated for another five to ten seconds if the eggs are exceptionally dirty.
5. Use a final rinse of clean water heated to 140 degrees F. A hose with a spray attachment works satisfactorily.
6. Dry the eggs thoroughly by directing a blast of hot air over the baskets or trays. Once the eggs are dry, pack them in pre-cooled egg cases, fillers, and flats.

Dry cleaning eggs: Many egg-buying organizations prefer to handle eggs that have been cleaned by dry, abrasive methods. The equipment used in this method ranges from a small emery-cloth buffer brush to elaborate sanding machines and automatic abrasive units. Small hand brushes or motor-driven buffers are particularly suited for cleaning eggs that are soiled only slightly.

There are some disadvantages to the dry cleaning methods. Additional time is required to do a satisfactory job. Scratching and marking of eggs is an objectionable feature, especially in brown eggs. An increase in the number of cracked and broken eggs usually results from the extra handling. And, finally, it may be difficult to clean badly soiled eggs properly when using a dry, abrasive method.

PRESERVATION OF SURPLUS EGGS

The preservation and sale of frozen eggs may be a profitable poultry farm activity. The breaking out and sharp freezing of yolks, whites, or whole, mixed eggs will enable you to salvage cracked, leaking, and soft-shelled eggs. Those with small blood clots or spots and those too small to market profitably as shell eggs may be included with your frozen stock.

How to Freeze Eggs. Frozen eggs may be sold to confectioners, bakers, or manufacturers of such products as mayonnaise. If put up in small containers, they may be conveniently used by your family or sold to neighboring

housewives for storage in home freezers. The steps in the preparation of frozen eggs are as follows:

1. Break open one egg at a time into a small cup, saucer, or bowl. Examine the contents of the egg for signs of spoilage. Make certain the yolk and white of the egg are free of objectionable odors. Small blood spots, if present, may be removed and the remainder of the egg frozen. Do not save eggs with bloody whites or with a large amount of blood on the surface of the yolk.

2. If there is any evidence of spoilage or rotting, discard the egg. Thoroughly wash and rinse the cup or bowl after the spoiled egg has been discarded. One egg with an "off" flavor or objectionable odor will ruin an entire batch.

3. After the egg has passed the initial sight and smell test, place it with other broken out eggs in a large mixing or freezing container. Gently mix the yolk and white together with a fork or an electric mixer at low speed. One tablespoon of sugar may be added to each cup of fluid to prevent the mixture from thickening when the eggs are thawed.

4. Select a storage container that will be suitable for the final user of the product. If you are planning to freeze small quantities, put the product up in wax-lined pint or half-pint freezer boxes. Be sure to use containers that are both vapor and waterproof. Commercial outlets will usually buy their frozen egg stock in "tin cans" that hold up to 30 pounds of mixed yolk and whites.

5. Place the filled containers in the sharp freeze compartment of your unit. Recommended freezing temperatures range from 10 to 30 degrees below zero. If your freezer will not drop the temperature below zero, a longer time will be required for adequate processing of eggs. Allow adequate headroom in each container for expansion of the product if slow methods are used.

6. Completely thawed eggs should be used within 12 hours. If the eggs are to be used on the farm, freeze them in units that may be utilized for one meal or for preparing one batch of baked goods.

7. Frozen eggs may be stored with little or no loss of flavor for 12 months or longer. The temperature for storage should be kept at zero or below.

The Water Glass Method. Eggs may be stored safely for as long as six months with the water glass or lime water methods which will be described. During the months when eggs are plentiful, carefully select as many clean, sound, and unwashed eggs as you wish to preserve. An earthenware crock or large jar with a capacity of at least six gallons of liquid should be used. Boil and cool enough water to make 9 quarts of soft water. Add 1 quart of water glass (sodium silicate) to the 9 quarts of water and mix well. Pour the solution over 15 dozen eggs that are unwashed and free of cracks or

checks. Cover the eggs with at least 2 inches of the water glass solution. Cover the top of the crock with a layer of brown paper and store in a cool place until ready to use.

The Lime Water Method. Add 2 and one-half pounds of unslaked lime to 3 gallons of boiled and cooled water. Let the solution settle for ten minutes. Then pour into a 6-gallon crock. Do not use the sediment at the bottom of the solution. Add 15 dozen sound and clean eggs to the lime water. Cover with brown paper and store until ready to use.

A prepared water glass paste may be purchased from your poultry supply store. Use the same precautions in selecting clean, unwashed eggs with sound shells. Spread the paste over the entire surface of the egg and store in a cool place.

PRODUCTION OF HATCHING EGGS

In many farming communities there is a ready market for the sale of hatching eggs. Many hatcherymen are unable to secure enough fertile eggs from their own breeding flocks to meet the demand for day-old chicks. They will often seek out poultrymen who are willing to contract for the production and sale of hatching eggs. In some areas, brokers arrange to buy fertile eggs for interested hatcheries. The price paid for hatching eggs may range from 25 to 40 cents a dozen above the prevailing wholesale market prices. However, this premium does not represent clear profit. Hatching eggs cost more to produce than regular market eggs. Production costs include a blood-testing program to detect pullorum carriers, increased feed costs, and the expense of rearing the breeding cockerels.

Blood Testing. All breeding stock should be blood-tested and found free of pullorum infection. A hatchery representative or an official tester operating under the provisions of the National Poultry Improvement Plan (*See Page 28*) may conduct the test on the premises or draw blood samples to be sent to an approved poultry diagnostic laboratory. Positive reactors are potential sources of infection and should be removed from the flock. If reactors are found, the flock should be retested until all blood samples are negative.

Breeding hens may be selected at the time the birds are handled for the pullorum test. The selection may be conducted by the hatcheryman or a representative of the National Poultry Improvement Plan and will be based on the bird's physical characteristics and evidence of past performance. Expenses involved in blood testing and selecting breeders must be considered when figuring the costs of producing hatching eggs.

Rearing the Cockerels. The hatchery to which you will be selling fertile eggs usually will supply you with cockerel chicks six to nine months before the start of the breeding season. (The practice of bringing adult birds onto the farm is not recommended. They may cause the spread of disease

among your flocks.) Having received the cockerel chicks, whose parents most likely have impressive production records, it becomes your responsibility to feed and care for them throughout the breeding season. Some of these birds will fall by the wayside as victims of disease, predatory animals, vices, or other conditions that cause flock mortality. To have enough male birds for the entire season, three or four cockerel chicks should be started for every adult cock bird you will need. The reserves will make up for losses from culling and normal mortality. The total number of males required will vary with the type of birds being raised. Leghorn matings, for example, need one cockerel or cock for every 15 to 20 hens or pullets. Heavy breeds, such as Rhode Island Reds, Barred Rocks, and New Hampshires, require one cockerel or cock for every 10 to 15 pullets or hens. Brahmas and Cochins should have one breeding male for every 8 to 10 pullets or hens. In figuring your hatching egg costs, remember that for every breeding cockerel you house and feed you could be caring for one and possibly two egg-producing hens.

Increased Feed Costs. Breeding stock must have a specially balanced diet to assure the production of fertile eggs with a high rate of hatchability. Breeder mash is more expensive than regular layer mash. It must be fortified with sources of riboflavin, pantothenic acid, vitamin B_{12}, and feedstuffs containing the so-called "animal protein factor." Hatchability may be affected by deficiencies in vitamins A, D, and E, riboflavin, pantothenic acid, pyridoxine, vitamin B_{12}, or manganese.

Loss of Egg Production. Some strains of heavy breeds are ideal for producing broiler replacement chicks. But not all of these birds can lay claim to outstanding egg-production records. If your hatcheryman wants eggs from the matings of these meat-strains, you must carefully weigh the premiums paid for hatching eggs against the potential revenue that could be obtained by housing an equal number of high-producing layers.

Breeding flocks also are under more physical strain than birds producing market eggs. The wear and tear of a breeding season may result in more culls and a higher rate of adult mortality. Hatching egg production calls for close supervision and rigid culling of the flocks. Eggs must be handled and selected carefully before they are packed and sent to the hatchery. The time required to care for breeding flocks may be spent more profitably managing the remainder of your poultry enterprise.

MANAGING THE BREEDING FLOCK

The establishment of a breeding flock should be well planned. During the course of and prior to the breeding season, you will get help and advice from the hatchery owner or his serviceman. They will be vitally interested in the well being of your flock. The hatcheryman will make arrangements for selecting breeding hens from your flocks. They may even request that

you raise a particular strain, family, or breed of bird. If the eggs from your farm are to be used for hatching broiler chicks, the breeder will have these qualities in mind: rapid and efficient growth; early maturing and quick feathering; good conformation, including blocky body, plump breasts, and well-developed legs; and strong, natural resistance to disease. The qualifications for laying stock breeders are discussed on Page 27. The hatcheryman may supply you with cockerel chicks months before the start of the hatching season. If he is a participant in the National Poultry Improvement Plan, he will probably ask the local or regional N.P.I.P. representative to check your flock and arrange to conduct pullorum tests. In some areas you may be requested to follow definite vaccination procedures in regard to bronchitis and Newcastle disease. Hens inoculated against Newcastle or bronchitis will produce chicks with temporary protection against these infections. The immune bodies carried in the blood stream of the hen are transmitted to her eggs and subsequently to the hatching chicks. This immunity is short-lived and a carefully planned vaccination program must be carried out to fully safeguard the health of the broiler or laying flocks.

If hatching eggs are to be produced on a year-round basis, it may be wise to raise and house a high percentage of young breeders. Some poultrymen prefer to raise the cockerel and pullet chicks together in the brooder house, growing pens, or on range. The candidates for the breeding flock are carefully selected as the birds approach maturity, and one cockerel is added for every 10 to 15 pullets. Mixing males and females throughout the growing period may reduce the incidence of fighting among the cockerels. Disturbance of the pullet flock at the start of the mating season is also minimized.

Flocks producing hatching eggs should be placed either on all-mash breeder rations or on breeder mash and scratch grain at least one month before their eggs are to be saved. Protein levels should never be less than 15 per cent during the breeding season, regardless of the feeds or feeding system used.

Older breeders may be given a rest from laying for one or two months before the hatching season begins. The birds may be forced out of production by inducing an off-season molt. This is done by abruptly turning off night or late afternoon lights and curtailing mash feedings until egg production has dropped to 95 per cent of normal. Scratch grain may be hopper-fed during this period. Regular mash feedings are resumed once production has fallen off and a majority of the birds have started a full body molt. Recent experiments have been tried using injections of the female hormone, progesterone, in bringing on the out-of-season molt. Forced molting should be preceded by rigid culling and a careful selecting of breeding pen candidates. An unnecessary expense will be incurred carrying birds through a two-month vacation from laying unless they show definite promise as breeders.

When male birds are to be added to newly formed breeding pens, disturb the pullets or hens as little as possible. Place the male birds in large crates in the breeding pen for two or three days. Give them plenty of fresh water and feed. When the hens or pullets are accustomed to their presence, the males may be released. Let them run with the hens for two weeks before you start saving eggs. (A moderate number of fertile eggs may be gathered for five to seven days after the males have been removed from the pens.) If cockerel replacements are needed after the season has started, it is best to crate the birds and put them in the pens after dark. Introducing new males during the daylight hours may result in their being set upon by the older members of the group.

Alternating breeding males may assure maximum fertility of hatching eggs. Some males, unfortunately, prefer to mate with certain hens or pullets and completely ignore the rest of the breeding flock. To offset the effects of these preferential matings, two separate groups of males are used. Each group is allowed to remain in the pen for a day or more. Then they are replaced for an equal amount of time by other males. Although this system is not conducive to the keeping of accurate progeny records, it does tend to increase the number of fertile eggs laid.

INCREASING HATCHABILITY

Hatcheries pay a premium for eggs with a high rate of hatchability. You may receive a bonus of 3 to 5 cents a dozen if your eggs hatch out 75 per cent healthy chicks. Hatches of 85 per cent or better may earn a bonus of 9 to 10 cents a dozen. If hatchability or fertility is lower than expected, look for possible faults in your management or in the birds themselves. Numerous factors determine hatching percentages:

1. **Heredity.** The ability to produce eggs that will hatch and develop into healthy chicks is transmitted from the hen to her offspring. Your breeding stock must be able to produce chicks that will satisfy the requirements of the broiler or egg producer. If all other factors contributing to good hatchability are accounted for, and if the fertile eggs produced still yield a low number of healthy chicks, you should consider a new source of replacement and breeding stock.

2. **Disease.** Male and female breeders that are diseased or heavily parasitized will not produce a high percentage of fertile eggs or eggs that will hatch. The flock must be strong enough to resist outbreaks of colds, bronchitis, or Newcastle disease. Be sure all vaccinations are completed well in advance of the laying and breeding seasons. Check all birds for lice or mites. Examine the roosts and nests for red mites. Initiate corrective measures at the first sign of infestation. Feed the birds a balanced breeding ration. Normal body weights should be maintained or slight gains made during the egg-production period.

Whenever possible, start with day-old cockerels and raise them to maturity on your own farm. Do not plan to use mature birds unless strict quarantine measures can be observed. (*See Page 125.*) Get your male birds from flocks that are known to be free of pullorum and any other contagious diseases. Cockerels are half your breeding flock. Select those with plenty of vitality. They are most apt to produce fertile eggs and healthy chicks.

3. **Weather and environment.** Egg production, fertility, and hatchability are affected by sudden changes in the weather. Birds that are exposed to excessive heat, cold, or dampness are susceptible to respiratory infections. A siege of coryza, bronchitis, Newcastle, or chronic respiratory disease may seriously damage the flock's health and interfere with normal productivity. The flock must have clean, dry, and well-ventilated quarters that are free of drafts. They must be protected against overheating and the effects of freezing weather. Roof and side wall insulation, insulating glass, aluminum roofs, and mechanical ventilation systems are among the housing features that may be put to advantage. You should be prepared to cool the breeding houses when the temperature in the pens goes above 90 degrees F. (*See Page 187.*) If the combs and wattles of male birds should freeze during the winter, their breeding efficiency may be greatly impaired. Thus, early dubbing of cockerels is recommended in areas that suffer from severe winters. The operation (surgical removal of the comb and wattles) is relatively simple when performed on day-old chicks. The operation also may be done when the cockerels are 12 to 14 weeks old. Debeaking and trimming of nails and spurs to minimize injuries from fighting may be done along with the dubbing operation.

4. **Molting.** Hens usually cannot lay and molt at the same time. They will either stop laying or will produce eggs that are low in fertility and hatchability. Male birds do not maintain a high level of fertility while molting. Breeders require plentiful supplies of all-mash breeder rations or mash and grain. They must have access to water at all times. Supplementary feedings of pellets may be used to assure maximum feed consumption. Provide additional feed hoppers for the male breeders. Small hoppers filled with scratch grain or pellets may be placed on the wall at least 1 foot above the floor to enable the males to feed undisturbed by the pullets or hens.

5. **Age.** The rate of fertility and hatchability will drop as the breeding stock gets older. Pullets and cockerels produce their greatest number of fertile eggs during the first year. However, the decrease in an older bird's fertility is somewhat compensated for by the availability of records that prove or disprove the bird's breeding worth. Having progeny-tested males is an essential part of a successful flock-improvement program. Older hens, while not as productive as younger birds, also have established records to show the quality of the chicks they produce. They also lay larger eggs that will hatch out heavier chicks. Only those birds that have been laying well

and have produced offspring of merit should be selected for second-year matings.

6. **Ratio of cocks to hens.** Too few or *too many* males assigned to a breeding pen may have an adverse effect on egg fertility and hatchability. The ratio of cocks to hens is discussed on Page 95.

CARE OF HATCHING EGGS

The hatchery that buys your hatching eggs at premium prices has a right to expect the delivery of clean, sound eggs that are uniform in size, shape, color, and interior quality. To meet their standards and justify the top dollar for your product, you should:

1. **Gather the eggs frequently.** If the refrigeration of hatching eggs is delayed, serious damage will be suffered by the living cells. Gather eggs at least four times and preferably six times a day. Frequent collections are especially important on very warm or extremely cold days. Development of the chick embryo will start at temperatures of 68 degrees F. or higher. Freezing of the contents of the egg will take place at temperatures below 28 degrees F.

2. **Cool eggs rapidly.** The optimum holding temperature for hatching eggs ranges from 50 to 55 degrees F. Humidity must be 70 to 80 per cent. Eggs should be packed in pre-cooled cases, fillers, and flats as soon after gathering as possible. For best results, do not let egg room temperatures go below 50 or 55 degrees F.

3. **Supply clean eggs.** Do not wash hatching eggs if it possibly can be avoided. Small flecks of dirt should be removed with sandpaper, emery cloth, buffer-brush, or steel wool. If washing is necessary, use water that is heated to 120 to 130 degrees F. and contains a suitable detergent-sanitizer compound. Rinse the eggs with clear, warm water, and wipe them dry before packing. (*See also Page 89.*)

4. **Pack eggs large end up.** Loose air cells and stuck yolks may occur when eggs are packed with the small ends up. Such eggs are poor hatching risks.

5. **Ship eggs twice a week.** Prolonged cold storage reduces hatchability. Have your eggs picked up or shipped at least once a week, and if possible twice a week. Never hold eggs longer than ten days before shipping or setting them. Older eggs require a slightly longer incubation period than eggs set within a few days after being laid. Hatching percentages decrease as the eggs get older. Eggs that are kept in one position for more than seven days before being set may develop stuck yolks. Eggs held longer than one week should be turned at least once daily. A 4" x 4" board placed under the center of the case will act as a fulcrum and permit easy tipping of the case from one end to the other.

DEFECTIVE EGGS ARE POOR HATCHERS

The United States Agricultural Research Center at Beltsville, Maryland, has published the following observations made on 47,950 newly laid white Leghorn eggs. Only 44.4 per cent of 1,894 defective eggs examined and set succeeded in hatching. This was in marked contrast to the 71 per cent hatch of the control, or normal eggs set. Conditions responsible for poor hatches included large blood spots, loose or tremulous air cells, air cells located at the small end of the egg, cracks or checks, and rough or thin shells. Eggs that are poorly shaped, too large (over 28 ounces to the dozen); or too small (under 22 ounces to the dozen) also have a reduced chance of hatching. To avoid low hatching percentages, do not ship eggs having these defects. Pack or set only those eggs that weigh 23 to 26 ounces to the dozen. Cracked eggs may be detected by candling or "belling" the egg. "Belling" consists of gently tapping two eggs against each other. If the shells of each are sound, a bell-like tone will be heard. If either is defective, the tone will be flat.

Chapter 15

CULLING TO INCREASE PROFITS

INTELLIGENT AND THOROUGH CULLING IS NECessary to derive the greatest profit from laying flocks. The continuous removal of poor as well as non-producing birds increases the earning capacity of the rest of the laying flock with a reduction in feed, labor, and other production costs. Your poultry income is not measured by the number of birds you house, but by the number of birds that are profit-makers. It is essential to the success of a culling or selection program that all birds be closely checked at frequent intervals. The birds may be rounded up with the help of nets or wire partitions, or they may be driven carefully through trap doors into catching crates. Some culling may be carried out by checking the birds by flashlight after they are bedded down for the night. Questionable birds are then caught up and examined individually.

Should you doubt the accuracy or wisdom of your culling technique, set up several separate laying cages for the birds in question. Evidence of their production, or lack of it, will be forthcoming in three or four days. It has been estimated that a well-managed culling program will produce savings of one ton of feed for every 1,500 pullets housed. During favorable egg-feed ratio years, culling is desirable; in low-profit times, it is an absolute necessity.

A good layer displays these characteristics:

Early sexual maturity. Leghorns should lay their first egg at four and one-half to five and one-half months of age. Heavy breeds should start laying from five to six months of age.

High rate of production. To show a reasonable profit, hens should lay at least four eggs a week, or 200 eggs or more a year.

Lack of broodiness. Broody hens are forced to take time off from their egg-laying chores. Hens with broody tendencies are not geared for a sustained, high rate of egg production.

Persistent egg production. A persistent layer will not start shedding her feathers until she has laid for 12 months or more, or a total of 200 to 300 eggs. Production-bred pullets can lay and molt at the same time.

The preceding four characteristics should serve as your guide to a culling or selection program.

The poor egg layers, which should be removed from replacement pullet or laying flocks include:

Late-maturing pullets. They fail to show signs of egg production at six or seven months of age.

Poor producers. These are "marginal layers," as indicated by their physical appearance and degree of yellow pigmentation. (*See Page 103.*) A pullet that has laid 30 eggs in her first three months of production usually is capable of laying 200 eggs per year or more. A record of 20 eggs or less during this time is the mark of a poor layer.

Broody hens. They should be identified with colored leg bands. These birds may be placed in a wire or wooden, slat-bottomed broody coop in an effort to break them of their broodiness. A second offense should lead to a quick trip to the cull coop. There should be little or no tolerance of broodiness in a commercial laying flock.

Early and slow molting birds. They are not profitable producers and may take up to six or eight months to resume laying once their annual molt has started. Under no circumstances should early molters be kept in laying or breeding flocks.

Physical Basis for Selecting and Culling. Certain external features of a hen or pullet offer a basis for judging their egg production. These features enable you to determine if a bird is laying and the approximate number of eggs she has laid. Features that establish past, present, and future production include the bird's general health and the condition and appearance of her comb, wattles, beak, vent, shanks, pubic bones, abdomen, and plumage.

To sustain a high rate of egg production a bird must have nearly perfect health and constitutional vigor at the time she is first placed in the laying house. The potential money-maker starts out with a full, strong body; a bright, alert eye; and an active, friendly disposition. The best layers will be those birds that are first off the roosts in the morning and the last to roost at night.

Comb and wattles. These features serve as dependable guides to a bird's state of health and sexual maturity. As the laying of the first egg approaches, a pullet's comb and wattles begin to enlarge. They become bright red and warm and waxy to the touch. (As the laying season progresses, they will lose some of the red color but remain full and smooth.) The comb and wattles shrink with the termination of egg production. A small, dried up comb is almost always a sign of non-production or poor health, or both. (*See Plates 18 and 19.*)

Abdomen. A bird in full production has an abdomen that feels loose, soft and pliable in contrast to the fleshy, hard, and contracted abdomen of an immature pullet or cull. During its growing period, a pullet has a hard

deposit of fat underneath the skin of the abdomen. As sexual maturity approaches, the ligaments, muscles, and other tissues begin to relax to permit the passage of the first and subsequent eggs. A marked expansion takes place to make room for an enlarged ovary, oviduct, and digestive tract. The hard layer of fat disappears as egg production continues.

Vent. A young pullet's vent is small, dry and puckered looking, and yellow in color. With approaching maturity it becomes more elliptical in shape, enlarged, and rather moist. It will have a pinkish tint. The vent stays this way as long as the bird is in production.

Pubic or pin bones. These bones may be felt on either side of the vent. The "spread" between these two bones, which represents the span or width of the pelvic arch, offers a valuable clue to the bird's laying condition. In an immature bird the spread measures from three-quarters of an inch to an inch. The pin bones are thick, stiff, and covered over with a layer of hard fat. With the onset of egg production and throughout the laying cycle, the pin bones feel thinner and somewhat pliable. The spread of the pelvic arch should then measure from 1 and one-half to 3 inches, or the distance spanned by three or four fingers. (*See Plates 20-23.*)

Keel bone. This bone is the backward projection of the breast bone (*sternum*) that extends into and forms the floor of the abdominal cavity of the fowl. With the start of egg production the ligaments holding the keel bone, as well as other bones in the abdominal cavity, relax and make room for the expanding organs of production. A span of three to five fingers, or 2 to 4 inches, from the ends of the pin bones to the keel bone is indicative of full production. A non-layer or immature pullet will have a pin bone to keel span of two fingers, or 1 and one-quarter to 2 inches.

Plumage. A bird's feathers provide a further indication of her egg-laying persistency. A hen still producing 10 to 12 months after her first egg has been laid will have feathers that are soiled, broken, and brittle. This display of old feathers at the end of the laying year means the bird has produced her quota of eggs without taking time out to shed her plumage. Such birds may be picked for a second year in the laying house or marked as likely candidates for the breeding flock.

Amount of yellow pigmentation. The appearance of the vent, the eye-ring, ear lobes, beaks, and shanks of a mature bird offer a guide to her *past* production. A ready-to-lay pullet will be deeply pigmented in all the tissues mentioned. The yellow pigment, called xanthophyll, is present in green feeds, such as alfalfa meal, clover, and other pasture grasses, and is found also in yellow corn. As a bird's egg production cycle begins, the pigments in the feed she consumes are carried from the digestive tract through the blood stream to the ovaries. Here they are used in the formation of the ova, or yellow yolks. Subsequent to the start of laying, the yellow pigment deposited in the vent, eye-ring, ear lobes, beaks, and shanks will fade or

bleach from these tissues in a certain order and at a fixed rate. This has a close relation to the number of eggs a bird has laid. (*See Chart 11.*) As egg production finally ceases, the yellow color returns to the vent, eye-ring, ear lobe, beak, and shanks in that order. The appearance of the pigment affords a basis for judging past production. It also provides information as to interruptions in the production cycle.

Vent color fades after ten eggs have been laid. Occasionally, fading may take place before the first egg is laid, the pigment from the feed having been diverted to the ovaries several days prior to the start of production. Pigmentation returns to the vent three to five days after the bird has stopped laying.

Eye-ring color (*around the inner edges of the eyelids*) will fade after ten or more eggs have been laid. These eggs are usually produced in a period of ten to 15 days.

Ear lobe pigmentation is found in Leghorns and other breeds with white ear lobes. The pigmentation fades after 15 eggs have been laid, usually over a period of 20 to 25 days.

The beak begins to fade around the base first and continues outward until the entire beak has lost its yellow color. The approximate number of eggs a hen will lay during bleaching of the beak is given in Chart 11. The yellow coloring returns to the beak within two weeks after laying ceases.

The skin and scales of the shanks and feet are the last to lose their yellow coloring. The bleaching starts in the soft tissues at the bottom of the feet and is followed, in order, by the front and back of the shanks, the tops of the toes, and finally, the scales around the hocks. Chart 11 gives the approximate number of eggs laid in relationship to the loss of color. When a bird goes out of production, the yellow pigmentation will return to the shanks in about four weeks.

CHART 11

Tissue Bleached	*Number of Eggs Laid*
Vent	5 to 10
Eye-Ring	10
Ear Lobe	15
Beak (*Starting at the base*)	
35%	15
50%	20
65%	25
80%	30
100%	35 to 40
Feet and Shanks	
Bottom of feet	68 to 75
Front of shanks	95 to 100
Back of shanks	160
Hock	180 to 190

Late molters. They make the best layers. Molting, or loss of feathers, is usually associated with the termination of egg production at the end of the laying year. The annual shedding of plumage during the summer months is nature's way of giving wild or domestic fowl a rest from laying their eggs and raising their broods of chicks. The four to six months' vacation is used to grow a new set of feathers before cold weather sets in. At the hands of our poultry breeders, domestic fowl have undergone some radical changes. Not the least of these is the development of strains of birds that can lay continuously for 12 months or more without a rest or seasonal molt. We may now raise pullets that will lay late into the fall or early winter months before molting or will continue to lay while they are molting. These are most often the birds that lay 200 to 300 eggs a year.

Management plays an important role in preventing untimely molts and subsequent losses in egg production. The balance between egg production and molting is established by certain hormones that are produced by the bird's endocrine system. This delicate balance can be thrown off by such things as *fright, abrupt changes in feeds or feeding procedures, shortages of water, sudden discontinuation of lights, or disease or parasitism.* Do not expect pullets and hens to lay during the summer months if they are underweight or underfed, parasitized, diseased, or otherwise subjected to poor management practices. Their normal reaction to adverse conditions is to shed their feathers and take a vacation from producing eggs.

Prevent unseasonal or early molts by keeping the flock well fed. Supplementary feedings of pellets or wet mashes is desirable during the late summer and early fall months. Any decrease in a bird's body weight during the crucial summer and fall months will almost always result in the halt of egg production and the start of a body molt.

A partial molt or neck molt occasionally may occur in pullet flocks that were hatched in January, February, or March. These birds may shed their neck and head feathers and possibly one or two primary wing feathers. Egg production, should it drop, usually is back to normal in two or three weeks. These partial molts may be prevented through the judicious and timely use of lights, and the feeding of wet mash or pellets. Increased feed consumption is of primary importance in warding off partial molts in the late summer and early fall.

The order in which feathers are shed during a molt follows a definite pattern. The head and neck feathers are the first to fall. These are followed by the breast and body plumage, including the back, fluff, and abdomen. An estimate of the length of time a bird has been molting is made by counting the number of new primary flight feathers that have been fully or partially grown. An early and slow molter ordinarily drops one primary feather every two weeks, starting with the one closest to the wing joint. The new

feathers can be identified by their shiny, new appearance, and their pink, soft quills. It takes six weeks for these new feathers to be full grown; two-thirds of the growth takes place during the first three weeks. If we assume that only one primary feather is dropped during each two week interval, we may use the following chart to represent the duration of a molt.

CHART 12

Order of Primary Feathers Dropped and Replaced	*Duration of Molt (Weeks)*	*Primary Feathers Dropped*	*Duration of Molt (Weeks)*
1	6	6	16
2	8	7	18
3	10	8	20
4	12	9	22
5	14	10	24

The molting schedule shown above will not be the same for all birds. A production-bred hen, for example, may drop two or more primary feathers at the same time. She may resume production before the completion of a full molt. The bird shown in Plate 24 has dropped five primaries simultaneously. When estimating molting time, count as one the new primary feathers of equal size.

Forced molting of laying flocks is sometimes practiced in an attempt to obtain peak production during the late summer and early fall months. Molting is induced by withholding feed or reducing water supplies for one day, or suddenly curtailing the use of all-night lights. Other abrupt changes in management will tend to bring on the off-season molt. The molt may be forced during the month of July and the flock allowed to rest for 8 to 12 weeks. At the end of this period, they are placed on a wet mash and pellet feeding and provided a 14-hour light day. These birds are generally marketed the following spring, or sooner if they should experience a slump in egg production. Despite the possible advantages of "controlled molts," most poultry experts agree that forced molting rarely brings an increase in the flock's total earnings.

Continuous Culling Schedule. Under most conditions, continuous culling should be carried out regardless of the age of the birds or the season of the year. While continuous culling is not without its drawbacks, it does keep you from feeding border-line cases, or birds that you mistakenly hope may resume production "after a short rest."

Pullets with narrow bodies, dull eyes, and pale beaks and shanks should be culled. These birds may be sluggish in nature, flighty, and easily disturbed. Puny pullets may manage to get enough food to sustain life, yet not produce eggs. Pale beaks and shanks in ready-to-lay pullets may mean that some physical disturbance, disease, or parasitism exists. Small, cold, and

shrunken comb and wattles are an indication that the bird's reproductive organs are inactive or immature.

A brood started in April should start laying in late August or mid-September. Leghorns come into production in four and one-half to five months; heavies in five and one-half to six months. By the time the flock is ready for the laying pens, you should have culled, selected, and segregated the birds according to their comparative sizes and stages of maturity. Remove pullets not in production by six or seven months of age. Barring accidents, mismanagement, or disease, the April hatched brood should be laying at a rate of 60 to 70 eggs a day for each 100 hens by late September. Keep the flock on a 14-hour light day to assure full production. They also may benefit from special feedings of pellets or wet mash in the fall and winter. Birds that start neck molts will probably resume production in a short time if given special attention. Expect to do your heavy culling during the spring and summer months.

A young pullet flock hit suddenly with bronchitis may suffer a drop in egg production from 70 to 80 per cent to a low of 10 or 20 per cent. Newcastle disease may cause even more severe losses. In both cases, adequate nursing, including a feeding program designed to increase mash consumption, may restore the flock to normal production within a few weeks. Recommendations for the care of flocks recovering from Newcastle disease or bronchitis will be found on Pages 168 and 195.

SELECTION CALENDAR*

JANUARY	Keep hens that complete their annual molt this month. Band, as good layers, pullets with well-bleached beaks and shanks.
FEBRUARY	Select hatching eggs and baby chicks with great care. Continue to band pullets that have thoroughly bleached beaks and shanks.
MARCH	Market non-laying hens and pullets that have yellow beaks and shanks. Break up broody hens and put legbands on them for marketing later, unless it is necessary to use them for incubation.
APRIL	Continue to market hens and pullets with yellow beaks and shanks, if they are not laying. Market broody hens that wear a leg band indicating previous broodiness.
MAY	Market old breeders not valuable enough to keep for another year. Watch for early molters; they are usually low producers. Remember that market prices for fowls are usually better at this time than later.
JUNE	Market early molters, thereby reducing feed costs. Try to maintain a 50 per cent production during the summer months. Begin annual selection this month.
JULY	Continue marketing molters. Early molters are usually slow molters. Market slow-growing pullets.

* Taken from United States Department of Agriculture Bulletin 1727, "Selecting Hens For Egg Production."

AUGUST	Keep hens that are still laying this month. Market those that are well into the molt. Remove weak and unthrifty pullets from the growing flock.
SEPTEMBER	Band, as persistent producers, hens that molt late this month or that have laid throughout the month. Band, as good producers, all pullets that begin laying this month.
OCTOBER	Continue to band hens that begin to molt during this month and those that are still laying. Continue to select and band the early maturing pullets.
NOVEMBER	Make up breeding pens comprising hens that matured early, laid at a good rate, were non-broody, and showed persistent production. Early hatched pullets that began laying this month will be fair producers. Late-hatched pullets that come into laying this month will be good producers.
DECEMBER	Band, as good layers, pullets that now have bleached beaks and show some bleaching in shanks. Early hatched pullets that begin to lay late this month will be poor layers. Hens that molt this month are persistent layers and may be kept for another year.
ANY MONTH	Remove all birds showing weakness or disease.

Number of Birds to Cull. Replacement during the course of the year will depend on the type of poultry operation you have, as well as on existing market conditions. Comparisons of feed prices, value of culls, cost of rearing replacements, and the price per dozen eggs will have a bearing on culling percentages. Keeping egg production at 50 per cent *and higher* throughout the year (this means 50 or more eggs for each 100 birds) is considered a sound practice. Remember that four eggs a week per layer are needed to show a profit over feed and overhead costs. A pullet or hen laying *less* than 200 eggs a year has no place in an up-to-date, commercial chicken farm. The manager of a cage operation may cull and replace up to 100 or 115 per cent of his flock in one year. In order to keep production up to 70 per cent or more the year around, he adheres to a schedule that calls for starting broods every four to six weeks. Caged birds that lay less than four eggs a week are culled from the flock. Three eggs a week pays their room and board; the fourth and subsequent eggs represent the margin of profit. The most profitable flocks of those reared on the floor usually have a high percentage of pullets to hens, or a ratio of at least 75:25, or the flock may consist entirely of pullets that are sold at the end of their first year of laying.

Raising three or four broods a year will enable you to maintain a continuous reservoir of replacement pullets. There are a number of advantages to be gained by keeping a high percentage of pullets in your laying flock.

1. Prompt removal and sale of marginal producers and non-layers means that some revenue is obtained from birds that might otherwise die.

2. Young birds produce high quality eggs *on less feed* than older birds. Pullets may earn up to 50 cents a year more than the older hens. A hen

usually suffers a 20 to 40 per cent loss in production during her second year of laying.

3. Carrying along fewer cull birds means a reduction in fixed overhead and other production costs.

4. Mortality is greater in older flocks than in predominantly pullet flocks. Deaths in summer among old birds may be excessively high.

5. Multiple brooding makes efficient use of equipment and labor during the entire year. Idle buildings and equipment do not contribute to your productive revenue.

6. A continuous culling and marketing program means receiving top prices for cull birds during the off seasons. Prices are low during the summer and high in the winter and spring.

7. The continuous sale of cull birds frees working capital for more productive projects. A frequent turnover of working capital is a requirement of a sound poultry enterprise.

8. A molting hen consumes between 1 and three-quarters and 2 pounds of feed during every week she is out of production. If laying mash and grain average 4 cents a pound, each vacation week costs you 7 or 8 cents in feed bills alone. Ten weeks of idleness mean an unprofitable subsidy of 70 or 80 cents.

Limit your housing of two-year hens to exceptional birds or those you are retaining for breeding. However, when cull prices are low and the cost of replacement pullets is high, you are justified in holding on to the better layers. Keep the percentage of second year hens down to 25 per cent of the flock or less. Select only those hens which, at the end of the first laying year offer evidence of persistent, high egg-production records. Well-bleached shanks and beaks and soiled, broken plumage are the "merit badges" worn by high producing, profitable birds.

Chapter 16

DRESSING CHICKENS ON THE FARM

Most poultry raised on commercial broiler and egg farms is shipped alive to centrally located markets for slaughtering and processing. However, some poultrymen have profitable retail outlets for a part or all of their broilers or cull fowl. These men usually do their own slaughtering and dressing on the farm prior to marketing the birds.

Stainless steel equipment, tile walls, and automatic feather pickers are desirable additions to a dressing plant operation with a volume output. But with careful planning and proper management you can do an excellent job on the farm using home-made implements. The procedures described in this chapter are effective no matter how few or how many birds are being slaughtered. If a large-scale slaughtering operation is planned, it is advisable to consult state, city, or federal poultry inspection agencies in order to comply with their specific requirements. Information regarding federal regulations may be obtained from the Poultry Branch, Agricultural Marketing Service, United States Department of Agriculture, Washington 25, D.C.

The Killing Room. Select a spot large enough to hold the essential pieces of equipment comfortably. A room with concrete walls, floor, and ceiling is preferable because it is easy to clean thoroughly. The floor must have enough drains to handle run-off waters from the scalding and washing of carcasses. A slope of one-quarter inch per foot leading to the drains is recommended by United States Department of Agriculture officials. Don't handicap your operation by working in a room that is too dark or poorly ventilated. Sufficient light, whether natural or artificial, and good ventilation not only add to your personal comfort, but enable you to do a better job of dressing the carcasses. Outlets for hot and cold running water are necessary for both the processing and the clean-up chores. The water must be heated to 180 degrees F. to clean and sanitize the equipment properly. A small sink and a generous supply of paper towels and liquid soap are helpful adjuncts.

Arrange your equipment to carry out the killing and dressing operation with the fewest possible motions and steps. Procedures include *crating and*

starving the birds prior to slaughter; *shackling*, or otherwise restraining the birds for *bleeding and sticking* (*piercing the brain*); and *plucking* the feathers, by hand or with mechanical pickers, after they have been loosened by *dipping in a full-scald or semi-scald* vat of hot water. Further steps include *pinning*, or removal of the small pinfeathers and vestigial feathers (*hair or down*); *chilling* the carcass to minimize the possibility of spoilage; *eviscerating* (*removing and cleaning viscera and discarding inedible organs and tissues*); and finally *cutting* the carcass in the style desired by the ultimate customer.

Crating. Handle birds selected for slaughter gently. Rough and careless handling will cause bruises that may ruin the appearance and depreciate the value of the finished carcass. If a net or catching hook is used to remove a few birds at a time, be careful not to disturb the rest of the flock. If an entire room or pen is to be marketed, use catching crates, nets, screens, or partitions. *Do not overcrowd the crates used to transport the birds to the killing area.* Deaths from suffocation, particularly on warm days, or bruising of the back, legs, and breasts may result.

Starving. Birds designated for slaughter on the farm should be starved for 12 to 18 hours before the kill. Give the birds constant access to fresh water during the starvation period. If crops and intestinal tracts are empty, there will be less chance of spoilage and fewer "green struck" birds. Starvation is especially important if the birds are to be prepared New York Dressed style with head, feet, and viscera intact. (*See Page 115.*)

Shackling. Remove the birds from the crates and place in shackles, funnels, or other suitable restraining devices. If shackles are used, place both feet through the hooks as shown in Figure 14. A stout cord or rope may be suspended from the ceiling or a crossbeam. The cord is placed around both legs and the loop secured by a small wooden button. The shackles, cord, or funnel, whichever device is used, should be high enough to enable you to perform the killing and plucking operations from a standing position.

Bleeding. A good job of bleeding is essential to the processing and preservation of poultry products. With the bird secured in the shackles or funnel, grasp the head firmly in the palm of the hand with your left thumb and forefinger extended on either side of the jaw. The mouth of the bird is forced open with the middle finger by applying pressure to the corner of the beak. The killing knife, a sharp, pointed, narrow blade 2 to 4 inches in length, is inserted so that the point reaches the left side of the roof of the mouth. The stick, or cut, is made diagonally across the mouth behind the angles of the jaw bones with a downward and outward stroke. An accurate cut will sever both jugular veins, which run together at the back of the neck. Avoid compression of the neck at this time. It will prevent or slow down the bleeding process.

After the "stick" is made, a *blood cup* weighing from 1 to 1 and one-half pounds is hooked into the bird's mouth. The weighted cup will minimize

the splattering of blood, and holding the bird's head in a downward position will help prevent the accidental swallowing of blood. The time required for a bird to lose a sufficient volume of blood is from 45 to 90 seconds. A poor cut or an abbreviated bleeding time may result in a "green struck" carcass and rapid deterioration of its keeping quality.

Sticking. This piercing of the brain causes a relaxation of the muscles that hold the feathers in place and enables you to pluck the feathers easily. Braining or sticking is accomplished by inserting the narrow-bladed knife

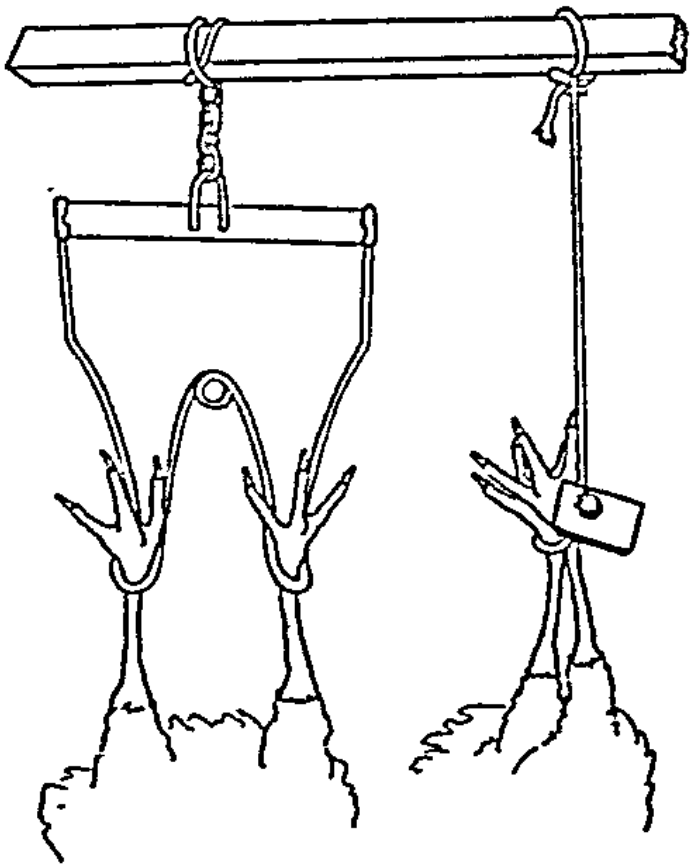

Fig. 14. The wire shackles on the left are used to suspend birds at a convenient height for the killer. The method shown to the right consists of a strong, light cord wrapped around both legs and held in place by the small block of wood at the end of the cord.

through the groove in the roof of the mouth and pushing the blade in a straight line toward the base of the skull. When the point of the blade pierces the rear lobe of the brain (the medulla oblongata), the bird will emit a characteristic squawk and fall limp. The knife should then be given a quarter turn to assure destruction of the vital brain tissue. An accurate stick is always accompanied by the involuntary squawk and the immediate loosening of the feathers. The rear lobe of the brain may also be pierced by inserting the knife through the lower eyelid and pressing forward in the direction of the base of the skull. The braining or sticking of chickens is essential if the carcasses are to be dry plucked. It will also help in the dressing of carcasses when the full or semi-scald processes are used.

Plucking. *Most commercial dressing plants use the soft or semi-scald process* in preparing carcasses for feather removal. The bird is bled for 45 to 90 seconds and is then completely submerged in a vat of hot water for 30 to 60 seconds. A thorough wetting of the carcass is required to assure loosening of the feathers. Broilers and fryers are usually dipped in water heated to *126 degrees F.* Roasters are submerged for 30 to 60 seconds in water of *129 degrees F.* The feathers of fowl and other older, heavy birds are loosened in water heated to *130 to 132 degrees F.* Rotation of the birds while they are immersed will facilitate the soaking through of the feathers. In addition, a small quantity of a detergent compound will help speed up the wetting process. A modification of the semi-scald process has been tried with some success by some of the larger dressing plants. Water of 136 degrees F. is used and the carcass submerged for 50 to 55 seconds. A peeling of the superficial layer of skin usually takes place, but does not damage the over-all quality and appearance of the carcass.

If a large number of birds are to be slaughtered each week, a small hot water heater equipped with a thermostatic control should be installed. The success of the semi-scald process depends on maintenance of water temperatures within 1 or 2 degrees of those recommended above.

The full-scald method of removing feathers is not widely practiced today. The use of waters above 142 degrees F. gives the meat a cooked appearance. There is also an excessive peeling and discoloration of the skin. A scalded carcass will not hold up in storage as well as a carcass that has been dry plucked or immersed in the semi-scald water vat.

A full-scald calls for water heated from 150 degrees F. to as high as 200 degrees F. The birds are bled in the manner described above and placed in the hot water just long enough to soak thoroughly and loosen the feathers. The brain does not need to be pierced. After the large feathers and pins have been removed, the carcass is immediately plunged into a cold water bath. Hot water within the full-scald range may be obtained by adding one part of cold water to two parts of boiling water.

Roughing. Removing the large feather tracts may be done by hand or with the help of mechanical feather pickers. The final job of pinning and removing the vestigial feathers is usually a hand operation. The feather tracts of the tail, wings, breast, back, sides of the leg, hip, neck, and body should be removed in that order as fast as possible. Should the plucking be delayed, the feather follicle muscles will begin to stiffen and the feathers will become firmly imbedded again. The feathers are grasped in the palm and fingers and pulled in an upward and outward motion in the same direction as the follicles. If they are pulled in the opposite direction, the skin may tear. Special care should be taken when pulling the feathers from the breast, neck, shoulders, and thighs. These parts of the carcass will tear most readily if mishandled. Small, bevel-edged knives, which may be obtained from a poultry supply house, may be used to advantage in grasping and withdraw-

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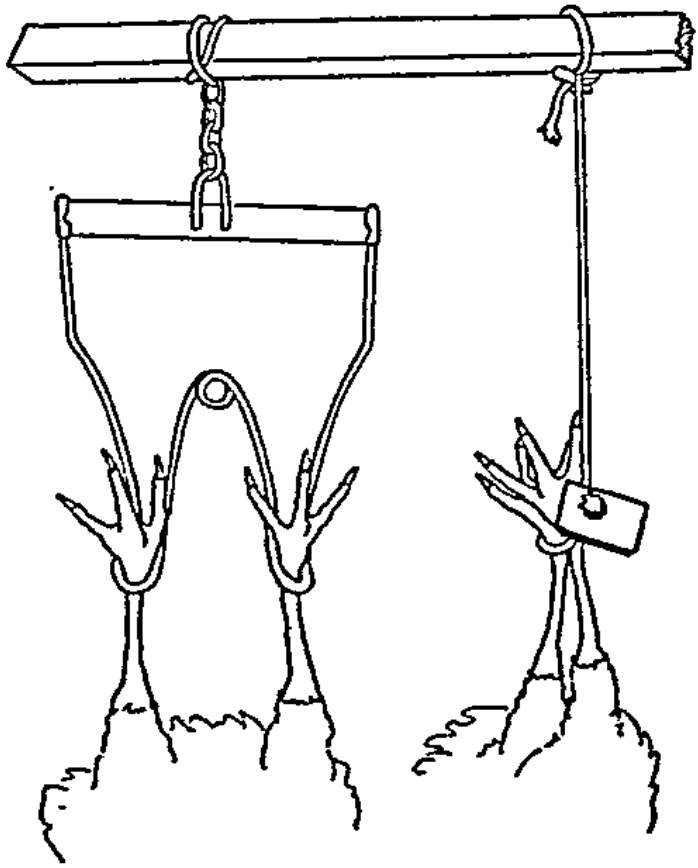

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ing the smaller feathers and pins. Down feathers on young birds or hairs on older birds should be burned over a suitable flame.

Chilling. After the bleeding, plucking, and pinning, the carcass should be plunged immediately into an ice and water bath. The internal temperature of the bird must be lowered to 35 or 40 degrees F. The rapid lowering of body heat will retard the growth and multiplication of bacteria that cause spoilage of meat. Birds should be left in ice water not longer than six hours. Air cooling is also possible. The carcasses are hung from suitable racks and placed in refrigerators at temperatures ranging from 30 to 35 degrees F. Complete cooling is usually accomplished in 18 to 24 hours. Freshly killed poultry carcasses should be kept under constant refrigeration at a temperature not higher than 35 degrees F. Wrapping or covers should be loose fitting to permit a free circulation of air.

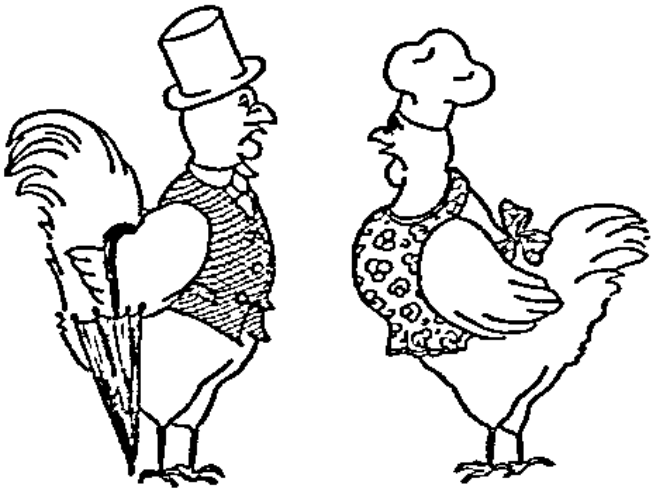

Fig. 15. New York Dressed and Ready-to-Cook chickens.

Dressing. There are two major styles in which poultry may be prepared for market. They are *New York Dressed* and *Ready-to-Cook*.

A New York Dressed carcass is sold with the head, feet, and viscera intact. Only the blood, feathers, and vestigial feathers are removed. The head of the carcass is covered with moisture-proof paper. A bird prepared New York Dressed style must have all excess blood flushed out of the mouth and throat. The crop should be incised carefully and flushed free of all particles of food. Any mash or grain remaining in the crop will turn sour rapidly. The odors may be absorbed by the meat and ruin the entire carcass.

Ready-to-Cook is the term used to describe a carcass that has been bled and picked clean of all feathers, including the down or hair, and is ready for the oven, broiler, or frying pan. The head is severed, the feet removed at the hock joint, and the entrails removed.

The removal of the entrails, or evisceration, starts after the feet and head have been removed and the bird has been vented. Venting consists of applying pressure on each side of the vent and expelling any fecal material that remains in the final portion of the intestinal tract. A small incision is made under the vent, with care taken not to cut into the wall of the intestine. By applying gentle traction the entrails, including the liver, gall bladder, spleen, and heart, are drawn to the outside of the body. The cut around the vent is then completed, and the final loop of the intestine is freed from its connection to nearby tissues. The opening may be enlarged to allow the cupped hand to slip into the body cavity. The lungs are reached easily and lifted from the pleural cavity.

Finally, the testes or ovaries are taken out. A longitudinal cut is made along the side of the neck for removing the trachea, esophagus, and proventriculus, or "true stomach." The body cavity is then rinsed thoroughly with clean, cool water and set aside to drain. The bile-filled gall bladder must be separated from the liver. Should the bladder rupture, rinse the bitter tasting fluid off the liver immediately. The gizzard is separated from the intestines. A circular incision is then made along the thick muscular wall until the inner, yellow horny layer is reached. With a little practice it will be possible to remove the lining, with any enclosed feed or grit, in one piece. If the lining gets cut, it may still be peeled from the edible portion of the gizzard. The chicken "giblets" consist of the cleaned gizzard, heart, liver, and neck. They should be cleaned and rinsed thoroughly, wrapped in waterproof paper, and replaced in the finished carcass. One small but important step in preparing a Ready-to-Cook carcass is the removal of the oil gland at the base of the tail. This gland, or sac, contains an oil with a strong odor that is used by the bird in preening her feathers. Dressed poultry should be packed in ice and sold within 48 hours of the time of slaughter.

"Green Struck" Poultry. A green discoloration appears in carcasses that (1) have not been bled properly, (2) have a high bacteria count because of faulty chilling or refrigeration, or (3) have not been starved adequately before slaughter. The green color is caused by a chemical reaction between the bacteria and the hemoglobin found in the red blood cells. The action is accelerated by the presence of an excessive amount of blood in the carcass. The growth of the bacteria is encouraged by high temperatures and delayed chilling of the carcass after slaughter. Should the intestinal tract be filled with food at the time of slaughter, a longer period of refrigeration and lower holding temperatures are required to remove the body heat effectively.

Adherence to the recommendations given above for farm slaughtering and dressing will reduce or eliminate the occurrence of "green struck" carcasses.

Ready-to-Cook roasters are usually sold whole. Broilers and fryers may be cut in half or divided further into wings, drumsticks, thighs, breasts, and back pieces. Fowl may be prepared in small pieces when it is to be used for

stewing or fricassee. Cutting the chicken into sections includes the following steps: First, the entire leg is separated from the rest of the body by cutting into the hip joint. The leg is held in one hand and drawn away from the body while the cut is being made. Further division is made at the joining of the upper and lower portions of the leg. This joint corresponds to the knee joint. The wings are then cut from the body. The joint at the shoulder girdle may be located by holding the wings away from the body as the cut is being made. If the wing tips are filled with unsightly pin feathers, they may be cut off with a small cleaver. The breast is removed with a bone cutter or sharp knife. The cut is made on a line parallel to and below the keel along the edge of the ribs. The breast and back may be cut into smaller pieces with the cleaver. Care should be taken not to mutilate the meat of the breast when the division is made.

Dressing Losses. A New York Dressed carcass will lose about 10 per cent of its live weight in blood and feathers. A bird prepared Ready-to-Cook style will lose about 25 per cent of its live weight in blood, feathers, feet, head, and inedible portions of the entrails. Chart 13 shows average weight losses sustained by the three most important classes of birds. When determining a fair retail price for chickens that are dressed on the farm, some farmers charge 10 cents a pound for shrinkage and 4 to 8 cents a pound (depending on the weight of the bird) for labor over prevailing live market quotations. A carcass should yield the following cuts: legs and breast, 45 per cent of the live weight; wings, 8 per cent; backs and necks, 19 per cent; liver, gizzard, and heart, 4 per cent; and head, blood, feet, and viscera, 24 per cent.

CHART 13

DRESSING LOSSES

Class of Bird	Broilers and Fryers	Roasters	Hens
Live Weight	3 lb.	5 lb.	5 lb. 8 oz.
New York Dressed (Avg. loss 10%)	2 lb. 6 oz.	4 lb. 5 oz.	4 lb. 9 oz.
Ready-to-Cook (Avg. loss 25%)	1 lb. 9 oz.	3 lb. 4 oz.	3 lb. 7 oz.

OFFICIAL CLASSES OF CHICKENS

Whether you sell your birds alive or dressed, retail or wholesale, you should be familiar with the official classes of chickens as designated by the United States Department of Agriculture.

BROILER OR FRYER — A young chicken (usually under 16 weeks of age) of either sex that is tender-meated, with soft, pliable, smooth-textured skin and flexible breastbone cartilage.

ROASTER	A young chicken (usually under eight months of age) of either sex that is tender-meated with soft, pliable, smooth-textured skin and breastbone cartilage that is somewhat less flexible than that of a broiler or fryer.
CAPON	An unsexed male chicken (usually under ten months of age) that is tender-meated with soft, pliable, smooth-textured skin.
STAG	A male chicken (usually under ten months of age) with coarse skin, somewhat toughened and darkened flesh and considerable hardening of the breastbone cartilage. Stags show a condition of fleshing and a degree of maturity (comb and spur development) intermediate between that of a roaster and a cock or old rooster.
HEN OR STEWING FOWL	A mature female chicken (usually more than ten months of age) with meat less tender than that of a roaster and with a non-flexible breastbone.
COCK OR OLD ROOSTER	A mature male chicken with coarse skin, toughened and darkened meat, and a hardened breastbone.

Caponette or capette are terms used to describe broilers or fryers of either sex that have been injected with the female sex hormone (*diethylstilbestrol*). The techniques of caponization are discussed on Page 58.

Home Freezing of Poultry. These suggestions will be helpful when surplus chickens are to be prepared for freezing:

1. Select only high-quality birds. Do not waste your time, or the capacity of your freezer, by processing low-grade birds. Be sure the bird has been bled properly, and that all feathers, pin feathers, hair, and down have been removed.

2. Freeze only Ready-to-Cook carcasses. Although it is possible to freeze undrawn chickens, the procedure is not recommended. Pre-cool carcasses for 18 to 24 hours before placing them in freezing compartments. The body temperature should be down to 35 to 40 degrees F.

3. Be sure the body cavity has been washed, rinsed, and allowed to air dry. Use a clean cloth or disposable paper towel to remove excess blood, food, or fecal smears. Dry the carcass before wrapping. Use a moisture and vapor-resistant wrapping or box for the carcass or individual parts.

5. Freeze quickly in the freezing compartment. The frozen bird may be stored at a temperature ranging from 10 degrees below zero to zero.

Avoid freezer burn. Freezer burn, or oxidative rancidity, is characterized by a darkening of the skin and the development of a typical "off flavor" to the meat. Tight wrapping to minimize exposure of the carcass to air will retard the oxidative process. Properly wrapped, frozen poultry will maintain its taste and quality for 8 to 12 months.

UNFIT FOR HUMAN CONSUMPTION

When you slaughter and process chickens on your farm, it is your responsibility to judge which carcasses, or their parts, must be discarded as unfit for human consumption. There are a number of diseases and conditions that make a carcass unwholesome. The following paragraphs, and the detailed description of diseases in Chapter 20, will help you learn to recognize these conditions.

Emaciation. It is a sign of prolonged sickness. A carcass that is excessively thin is not fit to eat. A thin bird may be suffering from tuberculosis, big liver disease, range paralysis, chronic respiratory disease, or chronic parasitism. Birds that have not fully recovered from other diseases, including Newcastle disease, blue comb or pullet disease, coryza, and infectious bronchitis, may be weak and emaciated. Their carcasses should not be used for food.

Tuberculosis. Condemn carcasses that show widespread lesions of tuberculosis in the liver, spleen, or intestines. If there are *any* lesions, however small, in parts of the body other than the liver, spleen, or intestines; or if the bird is emaciated, regardless of the extent of the lesions, the carcass should be destroyed. Tuberculosis nodules in the lungs, bones, or muscles are indicative of the widespread condition of the disease. Under no circumstances should such birds or their parts be used for human *or* animal food.

Chickens with tuberculosis *may* be used for food when the lesions are small in size and confined to the liver, spleen, and intestines, and if the carcass is well nourished and in good flesh. Organs and parts of the body showing lesions or contamination with infected material should be discarded. These recommendations are based on procedures followed by federal veterinary poultry inspectors. (*See also Page 216.*)

Botulism (*Limberneck*). This paralytic and often fatal condition is caused by the ingestion of spoiled foods contaminated with toxins formed by Clostridium botulinum bacteria. Eating maggots that have fed on spoiled meat also may cause a bird to succumb to botulism. Poultry suspected of having botulinum poisoning should not be used for food. Eating such meat may bring on acute food poisoning and death. Household pets should be prevented from eating the affected meat. (*See also Page 167.*)

Avian Leukosis Complex. Many of the birds culled and earmarked for slaughter will be found suffering from one form or another of this cancer of chickens. It may affect birds of all ages. United States Department of Agriculture officials recommend condemning the entire carcass if there is any evidence of the blood form of the disease, or if advanced lesions of the bone type of cancer are found. When the internal organs are affected, they recommend condemning any carcass that is emaciated, shows swellings on the skin, or has a marked enlargement of the liver, spleen, or other internal or-

gans. Birds whose wings, legs, or other parts of the body are paralyzed, and birds with shrunken or atrophied limbs should not be used as food. (*See also Page 161.*)

Gout. The presence of chalk-like deposits (*urates*) in the kidneys or pancreas or on the surface of the heart and liver may lead to a diagnosis of visceral gout. This condition may be found in birds with pullet disease, or "blue comb." The carcasses should be condemned if they show extensive urate deposits in the abdominal organs, *or* if other lesions suggestive of a general disturbance are found on autopsy. If *slight* deposits are found and there is no involvement of other tissues, the carcass may be passed for food after the affected organs have been discarded.

Toxemia. The word toxemia means "poison in the blood." The condition occurs when a local bacterial infection overwhelms the natural body defenses. Toxins from the bacteria get into the blood stream and circulate throughout the body. In addition to having a local infection, a toxic bird will be extremely weak and thin. Such birds should not be used for food purposes.

Septicemia. This term refers to the presence in the blood stream of disease-producing bacteria and their toxins. Specific diseases that may cause the symptoms and lesions associated with septicemia include fowl cholera (*Page 172*), paratyphoid (*Page 205*), and erysipelas (*Page 185*). Paratyphoid and erysipelas are particularly important for public health reasons. The paratyphoid organisms are capable of causing serious outbreaks of food poisoning and the erysipelas bacteria may cause painful skin lesions when transmitted to humans. Carcasses showing lesions suggestive of any of these three diseases should be regarded as unsafe for human consumption.

Ornithosis. This condition is commonly known as parrot fever or psittacosis. It may be transmitted to humans by direct contact with infected birds or carcasses. The disease is characterized by an atypical pneumonia in humans. Deaths as a result of this infection are not uncommon. Bring suspected outbreaks to the attention of your veterinarian and local or federal public health officials immediately. (*See also Page 208.*)

Do not market birds known to be suffering from and displaying symptoms of the following diseases or conditions:

1. Aspergillosis and other fungus infections (*See Page 160*)
2. Chronic respiratory disease (*Page 174*)
3. Newcastle disease (*Page 195*)
4. Bronchitis (*Page 168*)
5. Coryza (*Page 179*)
6. Laryngotracheitis (*Page 191*)
7. Fowl pox (*Page 207*)
8. Fowl cholera, typhoid, and pullorum (*Pages 172, 218, 209*)
9. Trichomoniasis (*Page 194*)
10. Blackhead (*Page 164*)
11. Coccidiosis (*Page 176*)

If the birds have recovered from these infections, their carcasses may be passed for food once the affected parts of the body have been removed and destroyed.

Inflammation. A part or system of the body may become inflamed after an infection or bodily injury. For example, improper feeding or the ingestion of spoiled food may cause an inflammation of the intestinal tract. This condition is called enteritis. Inflammation of the sac surrounding the heart (as seen in chronic respiratory disease) is called pericarditis. If the following inflammatory conditions are localized and there is no sign of a more serious disturbance, the carcass may be passed for food after the affected parts have been removed and destroyed:

1. Enteritis (intestinal tract)
2. Pericarditis (heart sac)
3. Salpingitis (oviduct)
4. Pneumonia (lungs)
5. Peritonitis (lining of abdominal wall and air sacs)
6. Arthritis (joints)
7. Abscesses on the breast, foot pad, or any area that is festering and suppurative

United States Department of Agriculture veterinary officials recommend condemning carcasses that are badly bruised or contaminated. If the bruised area is small, the injured part may be discarded and the remainder of the carcass used for food. A carcass should be condemned if, for some reason, it has been covered with or exposed to volatile oils (kerosene, gasoline, and others), paints, gases, or similar products that would impart an undesirable flavor or odor to the meat.

PRODUCTION HINTS FOR POULTRY FARMERS

The following suggestions have been compiled by the United States Department of Agriculture to help the poultry farmer increase and improve meat and egg production:

1. Buy good quality chicks bred specifically for meat or egg production.
2. Buy from hatcheries that do adequate pullorum testing.
3. Buy local chicks when local and distant chicks of the same quality are available.
4. Prepare brooder houses before chicks arrive. Provide a clean, warm, dry house with proper feeding, watering, and brooding equipment. (*See Plate 25.*)
5. Feed sufficient rations.
6. Feed rations for the purpose for which they were made; that is, as starting mash, broiler mash, or breeding mash.
7. Use deep litter for disease and parasite control and as a labor-saving device.

8. Vaccinate against Newcastle disease, laryngotracheitis, and fowl pox (and bronchitis) in localities where these diseases are prevalent.

9. Select fast-growing chicks and market at preferred weights; broilers should reach market weight of three pounds within ten weeks; turkeys should be marketed at 22 to 26 weeks.

10. Retain a maximum percentage of pullets for laying and keep an all-pullet flock when possible.

11. Keep either as large a flock as the farm facilities and labor will allow, or only enough poultry for the family table.

12. Cull non-layers from the flock monthly.

13. Produce and market clean, fresh eggs.

PART IV

REDUCE MORTALITY—INCREASE PROFITS

Chapter 17

PREVENTING POULTRY LOSSES

THE LOSS OF MEAT AND EGGS DUE TO DISEASE conditions, parasitism, and nutritional deficiencies adds approximately one-quarter billion dollars a year to the cost of this nation's poultry production. Domestic fowl are susceptible to a wide variety of ailments that impair their health and interfere with normal growth or egg production. The average farmer expects to lose from five to ten chicks out of every 100 birds he starts before they are six months of age. And 15 to 25 per cent of all the pullets housed may succumb to illness or parasitism before they complete their first year of egg production.

There are many excellent drugs and vaccines available to the poultry farmer to help combat these losses. However, prevention and control of disease calls for more than vaccination and the liberal feeding of wonder drugs. It combines the judicious use of drugs with a continuous effort toward improved management practices. The strongest line of defense against disease has been and will continue to be the well-bred, well-fed, and well-housed flock.

Causes of Poultry Diseases. They include the infectious, living agents such as bacteria, viruses, and protozoa, internal and external parasites, and fungi or molds. Losses may result from deficiencies in the diet, chemical or plant poisons, injuries, cannibalism, and exposure to extremes of heat and cold. Obscure conditions and general breakdown of the body may also contribute to the number of poultry deaths.

Viruses. Agents so small they can be seen only through the lenses of powerful electronic microscopes are responsible for Newcastle disease, infectious bronchitis, laryngotracheitis, fowl pox, psittacosis or parrot fever, epidemic tremors, and equine encephalomyelitis, a serious disease of horses

that is transmissible to chickens and man. The various forms of the avian leukosis complex are thought to be caused by a virus. Chronic respiratory disease (*air sac infection*) is produced by a "pleuropneumonia-like" organism that has certain characteristics of the virus group.

Bacteria. These living, microscopic organisms are somewhat larger than the viruses. Although hundreds of different bacteria have been isolated and identified by the bacteriologists, only a relatively small group have been incriminated as the causative agents of poultry infections. Pullorum disease, paratyphoid, typhoid, erysipelas, botulism, tuberculosis, fowl cholera, coryza, and streptococcus and staphylococcus infections are caused by disease-producing bacteria.

Fungi. These molds are low forms of plant life that may parasitize the internal organs and tissues of living birds. Three fungus diseases affecting poultry are aspergillosis (*brooder pneumonia*), favus (*white comb*), and thrush.

Protozoa. These microscopic, one-celled parasitic forms of animal life are responsible for coccidiosis and blackhead infections, trichomoniasis, infectious catarrhal enteritis, and two forms of bird malaria.

Internal and external parasites. They lower a bird's resistance to other more serious infections. They also affect weight gains and egg production. The important *internal parasites* (*those living inside their host's body*) include various species of tapeworms and roundworms. The common *external parasites* are mites, lice, fleas, and ticks.

Poisons. Plant or chemical poisons occasionally cause poultry deaths. Most reports of flock poisoning may be traced to errors in management. Carbon monoxide asphyxiation of young birds in brooders and burns caused by faulty disinfection of pens are frequently observed examples of poisoning. Birds may suffer ill effects and death from eating materials containing strychnine, arsenic, mercury, copper sulfate, lead, or large amounts of salt, sulfa drugs, and other chemicals. The ingestion of certain plants, including Black Locust, Corn Cockle, Cottonseed meal (in excess of normal tolerance), Coyotilla, and Crotalaria may cause death.

Nutritional diseases. Produced by deficiencies in vitamins or minerals are such diseases as rickets, perosis (*slipped tendon*) and "curly toe paralysis." Fortunately, these and other nutritional conditions are seldom experienced on commercial poultry farms.

How Poultry Diseases Spread. Disease-producing organisms or parasites and their eggs may be found in the droppings or in the discharges from the eyes, nostrils, and mouths of infected or carrier birds. (A carrier bird, without showing the symptoms of disease, may harbor the infection and be capable of spreading it to other birds.) The infective agents may be picked up by the flock from litter, feed, or water that is contaminated with the discharges of sick birds. Actual contact with a diseased bird or the breathing of

germ-laden air may result in infection. Severe outbreaks of parasitism and disease may be brought on by improper cleaning and disinfection of houses and equipment, careless handling of built-up or compost litters, or the use of contaminated ranges, exercise yards, or runs.

Hatching eggs sometimes are responsible for spreading poultry diseases. For example, the bacteria that cause pullorum disease, fowl typhoid, and paratyphoid may be carried in the yolks or ova of carrier hens. The organisms are passed to and infect the hatching chicks. These diseases are also spread when infected eggs are broken and consumed by healthy members of the flock. Poultry pathologists believe that the "pleuropneumonia-like" organism isolated in chronic respiratory disease cases may be transmitted through the egg.

How Poultry Diseases Get Their Start. You and the members of your family may be responsible for the unfortunate beginning. Perhaps you visit neighboring poultry farms and fail to make a complete change of clothing before handling your own birds. A sufficient number of infective bacteria may be carried on the soles of your shoes to introduce disease to the flock. Visitors to your farm, careless servicemen, poultry dealers, or vaccination teams may bring about costly disease outbreaks. A borrowed chicken crate, a contaminated vehicle, the purchase of infected baby chicks, and similar poor management practices are often the "unexplained" causes of poultry mortality.

Unsanitary conditions on the farm will encourage rodent populations, breeding of flies, and visits from stray dogs, cats, or wild birds. Insects, rodents, and wild birds may carry disease from one farm to another.

Instituting a vaccination program against bronchitis, Newcastle disease, laryngotracheitis, or fowl pox in an area where previous outbreaks have not been reported may mean that you have unnecessarily introduced the virus on the farm. Once you have vaccinated with a live virus you must continue to do so with all subsequent broiler or replacement pullet flocks.

RECOMMENDATIONS FOR MAINTAINING HEALTHY FLOCKS

Preventing poultry losses is a continuous and time-consuming job. All phases of your poultry operation may in some way affect the total number of birds you will cull, burn, or bury at the end of the year. You need not turn your farm into an isolated fortress to prevent losses from diseases or parasites. There are, however, certain basic procedures that deserve consideration. They are not designed to increase your popularity with less careful neighbors and poultrymen, but they should add dollars to your annual poultry income.

1. Carefully check your source of stock. Buy baby chicks from sources that test all breeding flocks and certify their freedom from pullorum. (*See*

Page 209.) A list of flocks and hatcheries cooperating under the provisions of the National Poultry Improvement Plan may be obtained from your county agent or extension poultryman, or by writing to the poultry department of the agricultural college in your state. (*See Page 229 for addresses.*) Information is also available from the United States Department of Agriculture, Washington 25, D.C.

2. *Start with disease-resistant stock.* Natural vigor, or the ability to ward off disease is a trait that may be passed to baby chicks from their parents.

3. *Purchase day-old chicks if possible.* Use day-old chicks or hatching eggs as a source of breeding or replacement stock. If you are selling fertile eggs to a nearby hatchery that is furnishing the breeding cockerels, insist on receiving a supply of day-old chicks. Partially grown or mature birds may be carriers of disease. If for any reason grown birds must be brought onto the premises, segregate them from the rest of the flock for two to three weeks. Place a few healthy birds from your flock in the pen with the quarantined newcomers. Watch them closely for any signs of infection. Be particularly careful to observe any evidence of respiratory diseases, such as coughing, sneezing, or running noses. If mature breeding stock is purchased, insist on having the birds blood tested to detect any carriers of pullorum disease.

4. *Keep incubators clean.* Carefully fumigate all new hatches. Pullorum disease may spread at hatching time from infected to susceptible chicks. Modern hatchery management calls for the fumigation with formaldehyde of all hatching chicks. This precautionary measure destroys the pullorum bacteria that may be present in the down and dust. A thorough cleaning and disinfecting of the incubator is recommended between hatches. High-pressure steam cleaners used with detergents or caustic soda are ideal for disinfecting houses and equipment in the hatchery or on the farm.

5. *Start chicks in clean, warm pens.* Well-bred chicks deserve quarters that will foster rapid growth and development. A clean, disinfected pen, a layer of clean dry litter, and the feeding of wholesome rations contribute to the rearing of disease-free stock. We do not recommend the use of old or so-called compost litter for young chicks. The possibility of outbreaks of internal parasites, bloody coccidiosis, and conjunctivitis (*inflammation of the eye*) negates what few advantages might be gained from the use of such litter.

6. *Raise different age groups separately.* Older birds are often unsuspected carriers of diseases and parasites. A definite drop in the incidence of big liver disease and range paralysis occurs when young flocks are brooded and raised with little or no contact with older birds.

Plan your work schedule so that you can attend to the needs of brooding and rearing pens *before* you enter the laying houses. If your farm is large

enough to warrant the hiring of extra help, it is advisable to have a separate caretaker for the growing and laying flocks.

Ranges should not be used more than once every three years in order to assure the destruction of infective eggs of parasites and bacteria. Place range fences so that a minimum of 6 feet separates your land from that of your nearest neighbor. The same rule should apply to the segregation of different age groups placed on adjacent strips of range.

7. Avoid overcrowded conditions. Crowding birds in brooding, rearing, or laying pens invariably results in poor weight gains, lowered egg production, and an increased incidence of diseases and parasites. Few farmers can grow broilers successfully on less than 1 square foot of floor space per bird. Mature fowl should be allowed 2 to 4 square feet of floor space depending on the size of the bird and the construction and arrangement of the laying houses and equipment. Consult agricultural engineers at your state college for recommendations on new poultry construction and housing capacities.

8. Feed your flocks balanced diets. An adequate supply of fresh, wholesome feeds will help produce maximum weight gains, efficient egg production, and resistance to disease. Moldy feeds should be discarded. They are a potential source of infection. To prevent feed waste from spillage, do not fill hoppers too high. Use wire platforms to minimize fecal contamination of feeders and waterers.

9. Maintain a deep, dry litter. Infectious bacteria and parasite eggs require moisture to grow and multiply outside the animal host. A deep litter kept dry by frequent stirring and raking will retard their development and keep filth-borne infections from spreading. Pits or roosts, if used, should be screened to keep birds from the accumulated droppings. A thin layer of superphosphate scattered daily over the droppings boards will help reduce the moisture and odors that attract flies.

10. Screen windows and other openings in poultry houses. Wild birds and pigeons may be responsible for the spreading of diseases and parasitic conditions. It is essential that they not be permitted to mingle with your flocks.

11. Discourage unnecessary visits to your farm. Careless visitors may carry disease organisms on their outer garments or footwear. Minimize visits by you or members of your family to other poultry farms. If you make such trips, change your clothes and shoes before working with your flock. Do not borrow crates, egg cases, wheel barrows, or other poultry equipment unless you are certain they have been thoroughly cleaned and disinfected. Insist on having your feed purchases delivered in new or sterilized bags. Buying feed in bulk or in 50 or 100-pound paper sacks will eliminate the problem of storing and salvaging used bags. (*See Plate 27.*)

12. Keep rodent and insect populations under control. Rats and mice consume costly feed supplies. They also carry many organisms capable

of infecting both man and fowl. Rat-proof buildings, foundations, and feed bins are essential to the organization of an effective rodent-control program. (*See also Page 133*). Flies, mosquitoes, and other insects spread disease. They are attracted to refuse piles or unscreened compost heaps, and they will breed on dead birds or any decaying organic matter. Continuous use of DDT, lindane and pyrethrin sprays, and other insecticides, the screening of manure pits, and the prompt removal, burial, or incineration of dead birds will discourage insects from breeding on the premises.

13. Cull frequently and carefully. Remove unthrifty and unhealthy birds. Do not rely on outside help for the culling of your flock. The art of culling is easily mastered with a little patience and practice. On the day the culls are to be picked up, crate and cart them to a point far removed from the flock. Have the poultry dealer sort and weigh the birds and transfer them to his own crates. Do *not* permit poultry trucks, no matter how clean they may appear, to come close to your poultry building. (*See Culling, Page 101.*)

14. Plan your vaccination program carefully. Effective vaccines are available for protection against Newcastle disease, laryngotracheitis, infectious bronchitis, and fowl pox. General suggestions for vaccination procedures are given on Pages 220-222. For additional information regarding local or regional conditions, consult your veterinarian or write to the agricultural or veterinary college in your state.

15. Gain sufficient knowledge of diseases. By doing so you will be able to recognize diseases as soon as they occur. Poultry disease diagnostic services are available in most states. Make use of them. Recommendations for preparing specimens and case histories for the laboratory are given on Page (151). In many areas there are qualified veterinarians who will provide diagnostic services at your farm or in their clinics. Until such time as the disease has been correctly identified, take precautionary measures that will prevent further losses. Be prepared to start emergency treatment pending final laboratory results.

Chapter 18

SANITATION

DISINFECTION

DISINFECTION IS THE ACT OR PROCESS OF DESTROYING disease-producing germs or agents. A *disinfectant* is any compound, solution, or physical means by which an object is freed of infection. The action of disinfectants may be greatly impaired or weakened in the presence of dirt, dust, litter, and droppings. They are most effective when applied to surfaces that have been cleaned first.

A recommended procedure for disinfection:

1. Remove feeders, hoppers, nests, and other movable equipment from the pen. Dump and discard mash that remains in the hoppers. Scrape droppings and other foreign matter from the equipment. Then wash and scrub equipment with a hot water-detergent solution or clean with live steam and water and spray with a suitable disinfectant. Sunlight is one of the most effective germicidal agents known to man. If possible, place the cleaned equipment in an area where it will be in the sun for a few days. Air drying will also help get rid of the odors of the disinfectant solution.

2. Remove litter, droppings, and nesting material from the pen. Soak down the litter to minimize the amount of flying dust. The job will be easier if mechanical scrapers and manure loaders are used. Many poultry houses are built with litter chutes leading directly to a suitable loading area. Others are fitted with double doors to permit a dump truck or tractor-drawn wagon to be driven into the house for loading.

Litter and droppings may be spread evenly and thinly on fields that will not be used for poultry range *for at least two years.* Poultry manure may be placed in screened compost sheds with cement floors. The compost may be used for garden or field crops or sold to greenhouse operators or farmers. If properly maintained, a compost heap will generate sufficient heat to destroy disease germs, parasites, and their eggs in four to six weeks.

3. Use a high-pressure water hose to wash the walls, rafters, and ceiling. The floors, walls, dropping boards, and pits should then be soaked and scrubbed with lye and hot water. A 2 per cent solution may be prepared by

adding one 13-ounce can of household lye to 5 gallons of water. (Or 1 pound of lye to 6 gallons of water.) Portable, steam cleaning units used with detergents or disinfectants are ideal for cleaning and disinfecting poultry houses and equipment in one operation.

4. Apply any of the following solutions to equipment and all accessible parts of the house with a hand or motor powered spray pump.

a. *Saponified or compound solution of cresol:* This disinfectant is one of the oldest and still one of the most effective germicidal agents in use. The chemical forms a soapy solution when mixed with soft or boiled water. A 3 per cent mixture is made by adding 4 ounces of the saponified or compound solution of cresol to 1 gallon of water. Because of its strong and somewhat objectionable odor, cresol solutions should not be used near stored eggs or other foods. And pens should be thoroughly air dried before placing chicks or pullet replacements in their new quarters.

b. *Sodium orthophenylphenate:* This disinfectant compares in germ-killing strength with the saponated solution of cresol. The chemical is safe to use and is free from objectionable odors. Readily soluble in water, it is most effective at temperatures above 60 degrees F. Power sprayers with special heating units are recommended for use with this disinfectant. Sodium orthophenylphenate is used in a 1 per cent water solution.

c. *Unslaked lime with lye and DDT:* Quicklime or unslaked lime is an inexpensive and effective disinfectant. It is used in the preparation of whitewash solutions, which in addition to their germ-killing powers also help "dress up" a poultry house or barn. The whitewash is prepared by first adding 1 pint of water to 2 pounds of quicklime. The product thus formed as a result of the reaction between the unslaked lime and water is called hydrate of lime, or water-slaked lime. Four parts of water are then mixed with one part of the slaked lime to make the preparation known as "milk of lime." The mixture should be thoroughly agitated before use. Whitewashes may be strengthened by adding 2 and one-half pounds of water-slaked lime to a 2 per cent solution of lye. DDT or other residual insecticides added to the whitewash solutions will help in the control and reduction of fly populations.

d. *Quaternary ammonium compound:* This is one of the most versatile and useful of farm drugs. Used alone or with water softeners or detergents, Q.A.C. solutions are effective germicidal agents. They help destroy odors, neutralize the virus of Newcastle disease, and may be used in washing dirty eggs or sanitizing drinking water. Quaternary ammonium compound disinfectants are odorless, non-caustic, and non-poisonous. When applied to clean surfaces, they leave a fine film that continues to kill and inhibit the growth of bacteria. Quaternary ammonium compound cannot be used with soap or certain liquid detergents, nor is it effective in certain areas where hard water supplies are prevalent. If water vaccination with bronchitis or Newcastle virus is planned, do not place any sanitizers such as quaternary

ammonium compound in the drinking water. Carefully rinse all traces of the chemical from the fountains before adding the vaccine to fresh water.

Fumigation with formaldehyde gas is widely practiced as a means of controlling the incubator spread of pullorum and other related diseases. Fumigation is carried out on the eighteenth to twentieth and twenty-first days of incubation. The gas is released by adding potassium permanganate to a 40-per-cent solution of formalin in a deep enamel pan. The pan should have a capacity approximately ten times the quantity of the chemicals to be used. For each 100 cubic feet of incubator space to be fumigated, 1 and one-sixteenth ounces (35 cc.) of formalin is poured over 1 level tablespoon (17.5 grams) of potassium permanganate. In the control of navel ill, or omphalitis, a double-strength solution is recommended. This solution is prepared by adding 2 and one-half ounces of formalin to 2 level tablespoons of potassium permanganate per 100 cubic feet of incubator space.

If potassium permanganate is not available, an alternate method of fumigation may be tried. Saturate 1 square yard of cheesecloth with two-thirds of an ounce (20 cc.) for every 100 cubic feet of incubator space to be fumigated. Place the cloth under incubator fans. Incubator doors should be kept closed for three hours or more with either method of fumigation to assure the penetration of the fumes to all corners of the machine. Between hatches, incubators should be thoroughly dry cleaned and vacuumed to remove dust, down, shell, and other waste. The machine should then be disinfected with a double-strength solution of formaldehyde. For best results, the incubator should be operated at a temperature of 99 to 100 degrees and a wet-bulb reading of 90 degrees. Formaldehyde fumes may be neutralized by sprinkling ammonia water over the affected area.

FLY CONTROL

Flies are more than a nuisance; they are a potential menace to health. Fowl pox, cholera, tuberculosis, and tapeworm infestations are only a few of the disease conditions that may be transmitted by flies. Many effective chemicals, including knock down and residual sprays and dry and wet forms of poison bait are available to help fight the fly population. However, no fly control program can succeed unless these basic rules of sanitation are observed:

1. Remove trash, litter, and old feeds from the areas around the farm buildings. Refuse heaps serve as breeding places for flies, crawling insects, and other vermin.

2. Burn, bury deeply, or place poultry offal and carcasses in well-constructed disposal pits. (*See Figure 16.*) During warm weather decaying organic matter may be crawling with maggots in one or two days.

3. Keep flies and other insects away from manure and compost heaps.

Flies will often deposit their eggs in warm, moist piles of chicken manure. These conditions are ideal for the growth and maturation of the fly larvae. Mature flies will hatch from the eggs in one week.

4. Screen the doors and windows in poultry houses.

5. Keep droppings on boards or in pits as dry as possible. Check water fountains and prevent and eliminate wet spots in the litter or droppings. Add hydrated lime or superphosphate to the litter and dropping boards or pits. This practice will add to the value of the manure as fertilizer, as well as help reduce moisture in the poultry house. Maggot growth can be effectively curbed by applying a powder or sugar solution of malathion, dieldrin, or aldrin to the droppings.

6. Allow manure under laying cages to "cone up" to a height of 1 to 2 feet. When the pile is removed (every three to five months), a base of dry

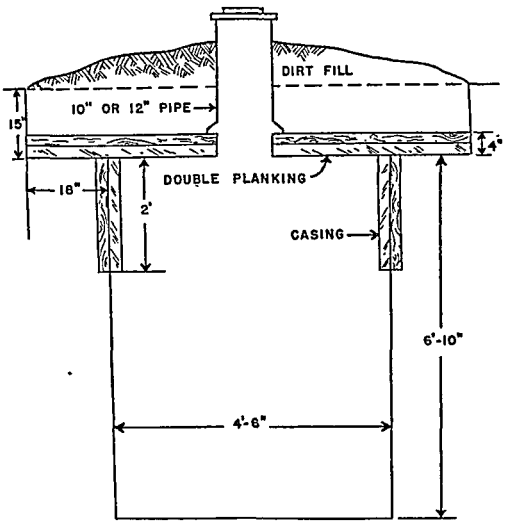

Fig. 16. A disposal pit. Dead birds are a potential source of infection to the healthy poultry flock. Carcasses should be burned, deeply buried, or placed in a well-constructed disposal pit. The pit should be dug so that drainage is away from the farm water supply, poultry yards, or range.

droppings 3 to 4 inches high should be left on the ground to help absorb the moisture from new droppings.

7. Use insecticides as often as needed during the fly season. Combine the use of knock-down space sprays and residual sprays with wet and dry forms of bait. Follow the manufacturer's directions for best results. A partial list of insecticides is given in the paragraphs below.

Knock-Down (Contact) Space Sprays. These insecticides may be used alone or combined with other chemicals. They frequently use a deodorized solution of kerosene as their base. Flies, mosquitoes, and other insects are destroyed on contact with the insecticide solution, which is sprayed or fogged into the air. Contact insecticides may be sprayed directly on the birds and are safe to use around exposed food products. Electric powered fogging machines or handy, high-pressure "bug bombs" offer a quick and convenient means of spreading the quick-killing sprays. Contact insecticides may be used to augment a fly-control program using residual sprays or baits, and they are definitely recommended on farms where fly populations have developed resistance to the residual sprays. The chemicals found in space sprays include pyrethrum extract and pyrethrin, rotenone, lethane, thanite, and other organic thiocyanates; allethrin and piperonyl butoxide, sulfoxide, sesame oil, and other synergists, which are principally used to increase the killing powers of pyrethrum.

Residual Sprays. The so-called residual insecticides—DDT is the best known—are usually sprayed on droppings, walls, posts, window sills, and other places or on objects where flies congregate or breed. When a fly rests on a treated surface, the chemical is absorbed through its feet and the insect is paralyzed and destroyed. Residual insecticides should not be used around exposed food products, nor should they be sprayed directly on the flock. Since these chemicals vary in their poisonous characteristics, the specific directions of the manufacturer should be followed. Residual chemicals include DDT, chlordane, methoxychlor, lindane, toxaphene, dieldrin, aldrin, chlorthion, diazinon, malathion, and others. Some of these chemicals may be used effectively alone or in combination with other drugs in the preparation of poison baits.

Poison Baits. This method of fly control has proved very popular with poultry and livestock farmers. It consists of mixing organic phosphates with either granulated sugar or a solution of sugar, molasses, or corn syrup. The dry or wet bait is then sprinkled or scattered on the floor of the house, feed room, posts, window sills, dropping boards or pits, and other places where flies gather. Frequent applications of the bait, from five to seven times a week, are recommended for good control. Poison baits are inexpensive and easy to mix and apply. Although highly toxic to domestic animals, the baits are usually scattered or spread so thinly that they are relatively safe to use around poultry and other livestock. Insecticides that may be used in the

preparation of poison baits include a mixture of TEPP and lindane, diazinon, malathion, and Bayer L 13/59.

RAT CONTROL

Rats are costly and obnoxious boarders on any farm. In addition to consuming and contaminating hundreds of dollars worth of feed each year, they destroy eggs, kill baby chicks, damage poultry buildings, and are capable of transmitting both human and animal infections. An effective rat control program consists of three basic steps: 1) reducing rodent food supplies and eliminating places where they may seek shelter and build their nests, 2) constructing rat-proof poultry and livestock buildings, and 3) destroying those rats on the premises with poison baits, traps, or poisonous gases. These practices work best when they can be undertaken by the entire community of farmers. Unless all farmers in the area cooperate by eliminating rats and protecting their farms against reinfestation, the routed rats merely move from one set of quarters to another. Rats may give birth to ten or more offspring six to ten times a year! To keep ahead of the prolific mothers, control measures must be planned on a year-round basis.

Harborages for rats must be eliminated. Do not have open and unsanitary dumps on the farm. Refuse piles provide both food and protection for the propagation of rat families. *Incinerate all poultry offal, carcasses, and farm or household garbage.* If proper incineration facilities are not available, bury waste material at least 3 feet deep or place it in suitable disposal pits. Garbage that is to be disposed of on the farm or picked up by municipal or private refuse collectors should be stored only in galvanized iron cans with tight fitting lids. Farm dumps, if used, should be covered with 3 feet of earth or ashes and the area compacted at least once a week.

Stack lumber, pipes, wood supplies, and similar items 12 to 18 inches off the ground. Leave a space around the stack so that periodic clean-ups may be made and the area checked for evidence of rat trails. Place sacked feed supplies on wooden racks or pallets. Allow 1 foot of clearance between pallets and 1 foot of clearance from the sacks to the wall. Wherever possible, store feed in rat-proof, metal bins. Avoid storing old machinery or obsolete equipment.

Rat proof your poultry buildings. Make liberal use of concrete in new buildings, especially in the construction of floors and foundations. The foundations should be at least 2 feet deep. Openings larger than one-half inch in diameter should be screened with one-quarter-inch hardware cloth. Cover ventilators, drains, sewers, pipe openings, and windows at floor level. Protect wooden sills and door edges at ground level against gnawing with a layer of 26-28 gauge sheet metal. Check old buildings and close holes and openings with hardware cloth, sheet metal, or concrete. Elevate wooden

droppings 3 to 4 inches high should be left on the ground to help absorb the moisture from new droppings.

7. Use insecticides as often as needed during the fly season. Combine the use of knock-down space sprays and residual sprays with wet and dry forms of bait. Follow the manufacturer's directions for best results. A partial list of insecticides is given in the paragraphs below.

Knock-Down (Contact) Space Sprays. These insecticides may be used alone or combined with other chemicals. They frequently use a deodorized solution of kerosene as their base. Flies, mosquitoes, and other insects are destroyed on contact with the insecticide solution, which is sprayed or fogged into the air. Contact insecticides may be sprayed directly on the birds and are safe to use around exposed food products. Electric powered fogging machines or handy, high-pressure "bug bombs" offer a quick and convenient means of spreading the quick-killing sprays. Contact insecticides may be used to augment a fly-control program using residual sprays or baits, and they are definitely recommended on farms where fly populations have developed resistance to the residual sprays. The chemicals found in space sprays include pyrethrum extract and pyrethrin, rotenone, lethane, thanite, and other organic thiocyanates; allethrin and piperonyl butoxide, sulfoxide, sesame oil, and other synergists, which are principally used to increase the killing powers of pyrethrum.

Residual Sprays. The so-called residual insecticides—DDT is the best known—are usually sprayed on droppings, walls, posts, window sills, and other places or on objects where flies congregate or breed. When a fly rests on a treated surface, the chemical is absorbed through its feet and the insect is paralyzed and destroyed. Residual insecticides should not be used around exposed food products, nor should they be sprayed directly on the flock. Since these chemicals vary in their poisonous characteristics, the specific directions of the manufacturer should be followed. Residual chemicals include DDT, chlordane, methoxychlor, lindane, toxaphene, dieldrin, aldrin, chlorthion, diazinon, malathion, and others. Some of these chemicals may be used effectively alone or in combination with other drugs in the preparation of poison baits.

Poison Baits. This method of fly control has proved very popular with poultry and livestock farmers. It consists of mixing organic phosphates with either granulated sugar or a solution of sugar, molasses, or corn syrup. The dry or wet bait is then sprinkled or scattered on the floor of the house, feed room, posts, window sills, dropping boards or pits, and other places where flies gather. Frequent applications of the bait, from five to seven times a week, are recommended for good control. Poison baits are inexpensive and easy to mix and apply. Although highly toxic to domestic animals, the baits are usually scattered or spread so thinly that they are relatively safe to use around poultry and other livestock. Insecticides that may be used in the

preparation of poison baits include a mixture of TEPP and lindane, diazinon, malathion, and Bayer L 13/59.

RAT CONTROL

Rats are costly and obnoxious boarders on any farm. In addition to consuming and contaminating hundreds of dollars worth of feed each year, they destroy eggs, kill baby chicks, damage poultry buildings, and are capable of transmitting both human and animal infections. An effective rat control program consists of three basic steps: 1) reducing rodent food supplies and eliminating places where they may seek shelter and build their nests, 2) constructing rat-proof poultry and livestock buildings, and 3) destroying those rats on the premises with poison baits, traps, or poisonous gases. These practices work best when they can be undertaken by the entire community of farmers. Unless all farmers in the area cooperate by eliminating rats and protecting their farms against reinfestation, the routed rats merely move from one set of quarters to another. Rats may give birth to ten or more offspring six to ten times a year! To keep ahead of the prolific mothers, control measures must be planned on a year-round basis.

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houses so that they are 12 to 18 inches above the ground. Extra protection may be gained by burying a strip of hardware cloth 2 to 3 feet around the house and bending the edge away from the house.

Place feed bins 12 to 18 inches above the ground and protect the edges and supporting legs with sheet metal strips. If possible, install rat-proof bins.

Do not have double walls made with wallboard or other insulating materials. Insulating boards should be nailed directly to the wall between the studding.

Reducing Existing Rat Populations. The following methods are suggested:

Trapping. This method of control may be employed in the home or in buildings where rats are few in number. It is often used to advantage for destroying rats that survive a poison bait or fumigation program. Also, when rats are killed by consuming poisoned food, the carcasses may remain in inaccessible places creating offensive odors. Trapping permits proper disposal of the bodies through incineration or deep burial. Spring snap, steel jaw, wire cage, and jump traps may be used. The Fish and Wildlife Service of the United States Department of the Interior makes the following recommendations regarding the setting of rat traps:

In trapping, proper placement is far more important than the selection of a bait. Rats follow natural runways as far as possible, running along walls and stacked materials, rather than cutting across the middle of the room in the open. Their instinct for stealth and desire for protection cause them to pass behind anything set or leaning against a wall. The best baited trap will rarely entice a rat into the middle of the room. On the other hand, a rat will frequently pass over a trap rather than detour wide into the open.

Despite its reputation, cheese is not an infallible bait. Bacon strips, a piece of fresh fish, or bacon-scented oatmeal is better. Such baits should be tied firmly to the trigger to prevent their being stolen without springing the trap. Do not allow dead rats to decay in the trap. If this should happen, scald the trap before re-using, but do not worry about human or rat odors on the trap. A freshly killed rat in a trap will not frighten other rats away; frequently live rats will feed upon it. Nor is it necessary to throw a trap away once a rat has been caught. If blood or entrails are stuck on the trap, scrape them off before using it again.

The longer a trap is in use, the more likely a rat is to approach it.

Baited traps are not always necessary. Enlarge the trigger surface of an ordinary snap trap with a square of cardboard or a piece of tin, thus making the entire trigger half of the trap treadle. A square of corrugated paper, with the trigger forced between the two layers of paper, will also serve. If desirable, a smear of bait can be rubbed on the surface.

Traps with the enlarged trigger surfaces should be placed in such a manner as to force the rats to cross over them, blocking a runway behind a box, a beam, or a ledge used as a runway. When laying flat on a surface, straw or shredded paper in a thin layer can be used to mask the trap. By using a hose clamp, with a long bolt projection, a trap can be fitted to a pipe by drilling a hole through the trap and fitting it over the projecting bolt. Essential to success is the need for sufficient traps. Do not expect to catch five rats with one trap. As with bait, put out considerably more than seems necessary.

Fumigating. The use of poisonous gas is an effective means of destroying rat populations. Calcium cyanide in dust or powder form is the most commonly used chemical. It is placed in rat burrows with specially designed foot or stirrup pumps. The nozzle of the pump is inserted 10 or 12 inches into the burrow. The opening to the burrow is closed off with earth and 4 to 6 short strokes are made with the pump. The pump valve is then switched to "air" and six or eight strokes are taken to drive the poisonous dust through the burrow. Upon exposure to the moisture in the air or in the earth, the chemical forms the deadly hydrocyanic gas. If gas is seen rising from other exits, or bolt holes, they should be sealed off with earth to prevent the rats from escaping. Government rat-control experts recommend breaking up the gassed burrows with pick and shovel and tamping the earth down firmly. If any survivors remain, they will reopen the burrow and the treatment can be repeated.

Cyanide gas should not be used in houses with dirt floors or alongside foundations where the burrows have been used to gain entry to the house. Cyanide gas is a deadly poison; its use in closed buildings is a job for trained and licensed exterminators. Gassing should be avoided on rainy, freezing, or windy days. Avoid exposure to the fumes or dust when handling the material. Don't forget to wash the chemical away should it spill on your hands or clothing.

Carbon monoxide fumes piped into the burrows from the exhaust of an automobile may be used to control rats. A minimum of five minutes running time per burrow is recommended. Although not as effective as cyanide gas, carbon monoxide is inexpensive and safe to use and is particularly useful when the burrows to be gassed are located under the floors of poultry or other livestock buildings.

Poisoning. Two highly effective rat poisons that may be used with a moderate degree of safety around children and livestock are red squill and warfarin. Red squill is obtained from a small onion-like plant that grows in the lands around the Mediterranean Sea. Cats, dogs, chickens, and other animals will not readily eat baits containing this poison. If the bait is consumed, a certain agent in the red squill will cause the animals, *other than rats,* to quickly vomit the poisonous material. Regardless of its relative safety, care should be exercised to keep children and household pets away from the bait. Red squill baits may be prepared by mixing one part (by weight) of the poison with nine parts of ground meat, cereal, fish or bread crumbs. (Or one level tablespoon of red squill to one cup of bait. Buy red squill with a minimum toxicity of 500 milligrams per kilogram.) Place a liberal amount of the bait in feeding stations in and around known rat runs.

Warfarin: Developed and licensed for manufacture and sale by the Wisconsin Alumni Research Foundation, warfarin is a chemical that interferes with the normal clotting of blood. The active ingredient is called 3-alpha-

acetonylbenzyl-4-hyrdroxcoumarin. It is odorless, tasteless, and harmless to the rat unless repeated doses are consumed over a period of five to 14 days. Death is caused by disintegration of the small blood vessels and uncontrolled, internal bleeding. Because of the ready acceptance of baits containing warfarin, no prebaiting of feeding stations is necessary. Warfarin is poisonous to all warm blooded animals, but only if large amounts of the material are consumed for several days. Baits are prepared by adding one-half pound of warfarin to 9 and one-half pounds of ground meat, yellow corn meal, or ground oats. When a dry bait is used, 1 quart of mineral oil per 20 pounds of the mixture will help the warfarin powder adhere to the meal. Three-quarters of a pound of the prepared bait should be placed at each feeding or bait station in cigar boxes, metal pie or cake pans, or other suitable receptacles. Place your feeding stations in rat runways or areas frequented by rats and mice. A board measuring 4 feet in length and 10 to 12 inches wide may be nailed against the wall over the feeding station at a 45 degree angle to provide a runway for the rats. It will also serve to keep pets and children away from the bait. Avoid locations where the bait may become wet. The feeding stations should be checked daily and replenished with fresh materials as needed for a period of ten days to two weeks. The stations should not be left without bait for more than 24 hours.

RAT CONTROL METHODS

The following recommendations for the placement of baits and for prebaiting are taken from the booklet "Rat Control Methods" prepared by the Fish and Wildlife Service of the United States Department of the Interior, in cooperation with the United States Department of Agriculture:

Bait Placements. The proper placement of the material is more important than the type of bait used. Rats seek shelter and protection in their movements. Baits placed in travel ways and harborages are far more likely to be found and sampled than those exposed in the open. Proper placement is important from the safety standpoint, too, if children, pets, and domestic animals are to be protected from exposure to the poisons. So, bait should be placed under cover whenever possible. An old board or a box can be leaned against a barn wall, covering a runway. Bait stations, consisting of an inverted box with a 2″ × 3″ hole cut in each end, can be used as a permanent exposure station. This has the added attraction of offering harborage when trash piles or other old rat shelters are cleaned up. In any event, place baits where rats are, and where they are moving. Do not expect them to come to you. Of equal importance is the distribution of enough bait. Put out more than you deem necessary. Baits should be made into a small ball about the size of a walnut or marble. Do not worry about the odor of your hands. Rats are as familiar with human scent as any other odor. Sometimes it may be desirable to wrap the baits in a small piece of tissue or waxed paper by simply cutting a four inch square, folding it over and twisting the ends. This helps some baits remain fresh over a longer period. Also, it provides a convenient means of handling dry bait mixtures, as well as an added safety factor for the protection

of other animals. The main objection to this method is that rats will often carry the torpedoes, as they are called, back to their nests, but not eat them. When it is essential that baits not be carried away, use a dry mixture, such as corn meal or a feed mixture, placing it in a shallow tray beneath a bait station.

Prebaiting for Rats. The most satisfactory results from poisoning operations are obtained when areas to be treated are prebaited. This consists of exposing fresh, unpoisoned bait materials, prepared exactly as poisoned baits will be later. Prebaiting will indicate which feeds will be most readily accepted, where baits will best be taken, and how much material will be consumed at a feeding. Often it will provide a satisfactory solution to stubborn cases, or when previous poisonings have been unsuccessful. It is simple, and the extra time thus spent is worth-while.

Remove all sources of food for rats insofar as possible, paying particular attention to such items as garbage cans, stored foods, grain bins, and exposed crates of fruit and vegetables. Do not remove trash, piled materials, or other nonfood items until after the baiting is completed. Do not block runways or burrows, as this might arouse the suspicion of the rats or cause them to move.

Use at least three kinds of food baits, preferably giving a choice of moist and dry foods. The following classes, most of which can be obtained from ordinary kitchen scraps, are suggested:

Meat.	Ground lean beef, beef melts, liver, sausage, bacon, chicken entrails, or canned meat.
Fish.	Fresh ground raw fish, canned fish, or cat food.
Cereal.	Bread crumbs, rolled oats, corn meal, chicken mash.
Vegetables.	Sliced tomato, green corn, carrots, or lettuce.
Fruits.	Cantaloup, watermelon, banana, or apple.
Other.	Peanut butter, sweet chocolate, dried milk, or raw eggs.

Expose the different types of bait to be tested in teaspoonful quantities side by side in all spots where rats may be likely to feed upon them. Place baits in the late afternoon or early evening, treating the entire area to be covered. Protect the baits from interference by cats, dogs, or other influences. Observe the results the following morning, noting the most acceptable bait, locations where the bait was taken, and the amount of the bait consumed. The exact locations of the most favored baits should be noted carefully, as it is there that the poisoned baits should be placed later. Remove all uneaten baits. If no baits should be taken readily, skip two nights and repeat with other baits until an attractive one is found.

Chapter 19

ANATOMY AND PHYSIOLOGY OF THE FOWL

THE CHICKEN IS A FAST-LIVING CREATURE compared to other domestic animals. The normal bird at rest has an internal temperature of from 105 to 107 degrees F. It breathes at a rate of 14 to 22 times a minute and has a heart action of 300 beats or more a minute.

THE SKELETON

The skeleton of the fowl, shown in Figure 17, is adapted for flight, although domestic fowl are no longer able to use this skill. The fused bones provide skeletal strength and the long hollow bones of the legs and wings lighten the weight of the bird. Additional aids to flight include the system of air sacs and the broad surface area and lightness of the feathered wings. The long, broad sternum projects far beyond the ribs and ends in a thin blade of bone called the *keel*. The well-developed muscles of the breast are attached to this bone. The sternum and its backward projection form the floor of the thoracic cavity and most of the abdominal cavity of the fowl. They help protect the vital organs of the body. The space between the keel or end of the breast bone and the points of the pubic bones is used in judging past egg production and the future capacity of laying birds. (*See also Page 101.*)

Additional support of the wings is provided by the two collar bones, or clavicle, as shown in Figure 17. The joined bones (*wishbone*) are attached at their base to the sternum by means of a ligament. The upper points remain apart, but are in contact with the other bones of the shoulder girdle.

The structure of the head is of some interest to the poultryman. The relative position of the nostrils and the openings in the upper and lower parts of the mouth should be noted. The upper opening communicates with the nasal passages. It is used to guide the sticking knife when debraining a bird prior to plucking. The lower groove leads to the larynx, trachea, syrinx, and lungs. A bird affected by the wet form of fowl pox may suffocate if this opening becomes covered over with exudate.

Bone disorders include breast blisters, deformed or crooked breast bones,

and osteopetrosis, or marble bone, a relatively rare form of the avian leukosis complex. Arthritis or inflammation of the joints, bumblefoot (*a local infection of the ball of the foot*), and tendo-synovitis (*an inflammation of the tendon sheaths*), are other diseases affecting the skeleton and its related structures. Rickets, caused by a nutritional deficiency, is characterized by softening and deforming of the bones.

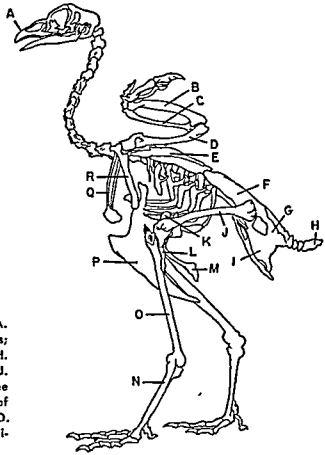

Fig. 17. The skeleton of a fowl: A. beak; B. ulna; C. radius; D. humerus; E. scapula; F. ilium; G. ischium; H. pygostyle (tail bones); I. pubic bone; J. femur (upper thigh); K. patella (knee cap); L. fibula; M. lateral processes of sternum; N. metatarsus (shank); O. tibia (lower thigh); P. sternum; Q. clavicle (wishbone); and R. coracoid.

FEATHERS

Some 8,000 feathers on the body and wings help protect a bird against injuries and provide an insulating coat against extremes in the weather.

A complete molt or shedding of the feathers takes place once a year, usually in the fall. The start of a molt is controlled by hormones secreted into the blood stream by the pituitary and thyroid glands. The process may be set in motion by sudden changes in environment, such as decreased water consumption, abrupt changes in feeds or feeding practices, undue exposure to drafts and cold, and the presence of disease. A full body molt is almost always marked by a complete halt in egg production. A partial molt, usually of the neck feathers, may cause temporary loss of production.

There are differences in the structure of feathers of male and female birds. The feathers covering the lower part of the neck, back, saddle, and tail of the

cock bird or cockerel are somewhat more pointed than those of a pullet or hen. This trait is one of the secondary sexual characteristics, others of which are the development of comb, wattles, and ear lobes, which are considerably larger in the male bird. Other secondary sexual characteristics include the voice (*a hen cackles, a cockerel crows*), and the comparative growth and size of the spurs (*larger in the male*).

THE DIGESTIVE SYSTEM

Beak. The bird uses its beak to scoop up food and water. The bird has no cheeks, lips, or *teeth*. Debeaking, or removal of part of the upper beak, does not interfere with the bird's eating. Food is swallowed when the bird raises its head and extends its neck. The negative pressure created by this motion and the force of gravity help pass the food into the esophagus, or gullet. (*See Plate 28.*)

Crop. Located 4 or 5 inches below the start of the esophagus, and little more than an enlargement of the gullet, the crop serves to store and partially soften the food before it continues its passage through the digestive tract. Virtually no chemical changes or digestion take place in the food during its short stay in the crop. A full crop is a sign of a healthy bird. Sick fowl almost invariably go to roost with empty stomachs and unfilled crops.

Proventriculus. This glandular stomach is the next organ the food reaches. Here certain gastric juices, or enzymes, that help digest food are secreted by the glands of the stomach before the food is passed into the gizzard.

Gizzard. Consisting of two powerful, oval-shaped muscles surrounding a tough, horny membrane, the function of the gizzard, assisted by grit or gravel, is to grind and crush coarse food particles. The presence of grit or gravel in the gizzard increases efficiency of grain digestion by at least 10 per cent. Grit is not so important to birds receiving all-mash diets.

Small intestine. It starts at the attachment to the gizzard and continues for approximately 56 inches to its juncture with the ceca and large intestine or rectum. The first portion of the small intestine is known as the *duodenum*. In the mature bird, it is 8 to 10 inches long and assumes the shape of a loop, which completely encloses the *pancreatic gland*. At the end of the duodenum are two ducts that empty from the pancreas and gall bladder into the intestine. The remainder of the small intestine is referred to as the *jejunum and ileum*. A small projection between the jejunum and ileum represents the remains of the attachment of the yolk sac. Ferments or enzymes secreted from the small intestine and the pancreas are primarily responsible for the digestion of fats, proteins, carbohydrates, and sugars. These nutrients are changed to more soluble forms and are absorbed through the walls of the small intestine, passed into the blood stream, and carried to the different parts of the body.

Large intestine. The fowl's large intestine consists of the rectum and

cloaca. It is 4 to 5 inches long. The *cloaca* serves as a common opening for the sperm or eggs from the male or female and for the waste products that are passed from the kidneys and intestines. The opening to the outside of the body is called the *vent*. At the juncture of the small intestine and the rectum are the *ceca*, two blind pouches or sacs 7 or 8 inches long. The rectum and ceca absorb water from the feces and urine prior to body elimination. The ceca also act as a site for the digestion of crude fiber. This process is aided by the action of enzymes and bacteria.

Liver. A two-lobed organ with a deep red color, the liver is the largest secreting gland in the body. It is responsible for the formation and secretion of bile. The green-colored bile may pass directly into the duodenum as it is formed; or it may flow toward the *gall bladder*, where it is stored and discharged into the intestines as needed. Bile aids in the absorption of fats by dividing the large fat globules into smaller particles (*emulsification*). Amylase, an enzyme present in the bile, assists in the digestion of carbohydrates. The liver is responsible for the formation and storage of glycogen, or blood sugar. This sugar is utilized as a quick source of energy. The liver also assists in the formation of uric acid, one of the end products of protein metabolism (*deamination*). Another important function of liver cells is to help counteract the effects of bacterial and mineral poisons (*detoxification*).

Although the normal color of the liver is dark red, it may have a yellow color during the first four weeks after the chick is hatched. This is due to a large amount of fat deposited in the liver cells. Birds in heavy production may also have an increased amount of fat in the liver.

Spleen. Though not a part of the digestive system, the spleen is described here because of its proximity to the organs of digestion. Under normal conditions, the spleen is a small, round, reddish-brown body located to the right of the gizzard and glandular stomach. The spleen functions as a reservoir for red blood cells, destroying those that have outlived their usefulness. It also produces white blood cells and antibodies against disease.

RESPIRATORY SYSTEM

Nostrils. The bird's nostrils are two slit-like openings located at the upper part of the beak. Air passes through the nostrils and nasal cavities, which are separated by a partition (*the septum*) of bone and cartilage.

Pharynx. This chamber is used for the passage of food and air. The air reaches the slit on the bottom of the mouth leading to the *upper larynx*. This portion of the respiratory system is connected with the *syrinx*, or voice box, by a long cartilaginous tube called the *trachea*, or windpipe.

Bronchi. These two main branches of the respiratory tree lead to the lungs. *The lungs* of the fowl are comparatively small. They are firmly attached to the ribs and occupy most of the thoracic cavity. Healthy lungs are pink and have a moderate degree of elasticity. Leading from the lungs are

continuations of the bronchi called *air sacs*. They serve to connect the lungs with the arm bones, ribs, sternum, and other hollow bones of the body. The air sacs are not essential to the life of domestic fowl. They are an aid to respiration when the bird is in flight. Under normal conditions the air sacs, nine in number, appear as thin, shiny, and transparent membranes. However, as a result of Newcastle disease or chronic respiratory infections the sacs may become thick and cloudy and may contain a yellow, cheese-like exudate. (*See Plate 29.*)

URINARY SYSTEM

Kidneys. Attached to and lying in depressions on either side of the back bone, the kidneys are dark red in color and consist of three distinct lobes. They start at the sixth rib near the end of the lungs and extend downward to the bones that make up the hip. The organs are somewhat crumbly in texture. It is almost impossible to remove them from their attachment to the backbone in their entirety.

The kidneys function primarily as organs of elimination. They filter foreign substances and waste products and pass them out in the urine. The kidneys also act to reabsorb and thus conserve water, blood sugar or glucose, and other substances that pass through its tissues. Urine secreted by the kidneys passes to the cloaca through the *ureters,* thin-walled, light-colored tubes that run parallel to the back bone. Any excess water is absorbed from the urine by the cloacal tissues. The remainder of the waste product, a white, pasty material, is voided along with the feces.

THE MALE REPRODUCTIVE SYSTEM

Testes. The male sex glands, unlike those of other domestic animals, lie within the abdominal cavity. They may be recognized easily as the bean-shaped, yellowish objects lying near the top of each kidney. Leading from each testis is a small duct, the *epididymis,* which acts as a collecting point for the sperm cells. This duct leads into the *vas deferens,* a twisted tube running parallel to the ureters, and transports the spermatozoa to the cloaca. The vas deferens enters the cloaca through a small projection or papilla. There is no functional penis present in the male chicken. The organ diminishes in size soon after the chick hatches. It remains as the small papillae on either side of the cloaca. During copulation the hen will crouch in a characteristic position to receive the male. The sperm are passed into the cloaca and migrate to the opening of the oviduct and toward the ovary, where fertilization of the egg takes place.

Fertility in the male decreases after the first year. Fertility is highest during the winter and spring and reaches its lowest point during the summer months. An increase in the amount of natural or artificial light a bird re-

ceives increases the activity of both male and female sexual glands. (*See Page 77.*) Conditions that may interfere with the number and quality of spermatozoa are a decrease in light, disease, parasitism, inadequate diets, and freezing of combs and wattles.

THE FEMALE REPRODUCTIVE SYSTEM

The female reproductive system consists of two parts, *the ovary,* which forms and releases the ova or yolks, and *the oviduct,* which is the long twisted tube that completes the formation of the egg while carrying it to the cloaca and vent. (*See Plate 30.*) The various steps in the formation of an egg are as follows:

Ovary. The site for the first stage in the development of an egg, this organ is located near the backbone on the left side of the bird opposite the last two ribs. The ovary is made up of thousands of small yellow spheres varying in size from the immature ovum, which is no larger than a pinpoint, to the mature yolk, which is about the size of a walnut. Each one of these spheres is capable of developing into a mature ovum to form that part of the egg we know as the yolk. However, only a small percentage of the total number will be developed and passed from the body as shelled eggs.

Funnel (infundibulum). This is the enlarged opening of the oviduct. As the mature ovum is released from the follicle, it is grasped by the funnel. Or the funnel may engulf the ovum after it has been discharged into the body cavity. Fertilization of the egg usually takes place as the yolk enters the mouth of the oviduct. The yolk remains in this first portion of the oviduct for about 15 minutes. At this point in its development, the egg consists of the yolk material, *the germ spot,* and a thin membrane surrounding the yolk called the *vitelline membrane.* The germ spot develops into the chick embryo when an egg is fertilized. The yolk, egg white, and shell provide nourishment and protection for the embryo.

Magnum. The magnum of the oviduct is responsible for the secretion of the white or albumen. After three hours in the magnum, and having received its layer of thick white, the egg is passed on by a series of muscular contractions to the next portion of the oviduct. This part is called the *isthmus.* The egg remains in the isthmus for about one and one-half hours, during which time it receives the two thin *shell membranes* that are secreted by the isthmus glands. The separation of these two membranes after the egg is laid causes the *air cell* or air space to form. (*See Plate 15.*)

Uterus. Holding the egg for nearly 21 hours, the uterus functions as the shell-secreting portion of the oviduct. The shell surrounds the yolk and thick white and is composed almost entirely of calcium carbonate crystals. During its stay in the uterus, the egg also receives an additional supply of thin white, which dilutes the thick, gelatinous mass of albumen laid down by the magnum. During this stage, the egg begins to assume its oval shape.

One other change takes place in the uterus. As the egg rotates through the oviduct, some of the thick white twists around on its long axis and forms two cord-like structures called *the chalazae*. The chalazae extend into the white from either side of the yolk. They help keep the inner contents of the egg near the center of the shell.

Vagina. This vestibule is the last portion of the oviduct through which the egg passes. During its short stay of about 30 minutes, the egg is covered with a waxy, mucoid substance that hardens on exposure to air. This coat, known as the *cuticle* or "bloom," helps protect the egg against evaporation

CHART 14

Gland	*Hormone Produced*	*Action*
Anterior Pituitary (*Base of brain*)	Thyrotrophic hormone (TSH)	Stimulates thyroid gland
	Adrenocorticotrophic hormone (ACTH)	Stimulates growth and secretions of adrenal cortex
	Follicle stimulating hormone (FSH)	Stimulates growth of sex organs, ovary, and testes
	Luteinizing hormone (LH)	Controls ovulation
	Prolactin	Induces broodiness, stimulates crop gland secretion in pigeons
Posterior Pituitary (*Base of brain*)	Oxytocin	Causes laying of formed eggs
Thyroid (*Each side of trachea near entrance to chest*)	Thyroxine	Body growth, energy; color and form of feathers
Parathyroid (*Round bodies near thyroid*)	Parathormone	Controls increase in blood calcium, egg shell, bone formation
Adrenal (*Head of each kidney*)	Cortical hormones and adrenalin	Energy, metabolism, helps regulate blood pressure and heart rate
Islets of Langerhans (*In pancreatic tissue*)	Insulin	Controls amount of sugar in blood
Intestinal wall	Secretin	Stimulates flow of pancreatic enzymes
Testes	Androgen (testosterone)	Comb development and other secondary sexual characteristics
Ovary	Androgen (estrogen)	Proper functioning of oviduct, secondary sexual characteristics, increases fat and calcium in blood to form yolks and shell

and bacterial spoilage. The cuticle is soluble in water and may be destroyed if the egg is washed.

Approximately one hour after the egg is passed from the body, another mature yolk is released from its ovarian follicle, initiating another cycle of egg production.

THE ENDOCRINE SYSTEM

The endocrine system is made up of glands whose internal secretions, or hormones, are released directly into the blood stream. The hormones help regulate the growth and development of the body and its many vital functions. The location of the glands and the name and action of the hormones they secrete are given in Chart 14.

Chapter 20

HOW TO DIAGNOSE POULTRY DISEASES

THE PAGES THAT FOLLOW ARE NOT AN ATTEMPT to make readers experts in the diagnosing of poultry diseases. There is no substitute for professional help from a qualified veterinarian or trained laboratory personnel. Still, every poultry farmer needs to have sufficient knowledge of poultry diseases to prevent their occurrence when possible, to arrive at a diagnosis when necessary, and to treat the birds until expert help can be obtained. Millions of dollars are spent each year to treat diseases that have been incorrectly diagnosed. A countless number of birds succumb to disease and parasitism because of delays in proper treatment. *Prompt detection* of symptoms and an *accurate diagnosis* are essential to effective treatment.

Correct diagnosis on the farm, by the farmer, is certainly not an impossibility. His knowledge of conditions preceding the disease, and of the flock's behavior, consumption of feed, and rate of egg production are helpful guides to diagnosis. But these factors must be combined with a knowledge of the diseases themselves and the symptoms they produce.

To recognize symptoms of disease you need to be familiar with the behavior of healthy birds. Look over the flock carefully at least twice a day. Don't let mechanical feeders or other automatic devices cause you to neglect checking the birds. Walk through the poultry houses after dark and listen for cold symptoms. If roosts are used, examine any bird that insists on using the floor as her perch. During the evening walk-through, mark obvious culls for removal the following morning.

Few diseases lend themselves to accurate diagnosis on the basis of symptoms alone. An autopsy, or post-mortem examination, is often necessary to determine the cause of the ailment or resulting death. Most ailments produce changes or lesions in the tissues of the body. To be able to recognize the normal and abnormal appearance of internal organs, practice doing post-mortem examinations on a few young chicks, growing and mature pullets, cockerels, and hens that have been culled.

Not all lesions can be seen with the naked eye. Microscopic examination by a trained pathologist may be necessary to discover tissue changes. In addition to examining the tissues of the diseased carcass, a pathologist may utilize a series of laboratory procedures, including bacteriological tests, blood and serum examinations, and chick embryo and other animal inoculations. A visit to the laboratory is recommended to confirm your farm diagnosis and to establish the cause of a disease outbreak. (*See Plate 31.*)

A POST-MORTEM GUIDE

Equipment needed to conduct a post-mortem examination, or autopsy, includes a sharp knife or scalpel, two pairs of scissors (one with a blunt point), one pair of dissecting forceps, and a bone-cutting tool or small tin snips. Autopsies ought to be conducted near the farm incinerator or disposal pit to facilitate disposing of the diseased carcasses. A table high enough for working in a standing position is desirable; a wide board placed over a barrel will serve as a temporary work bench. The carcass may be placed in a large enamel tray that lends itself to easy disinfection. A supply of running water, soap, and paper towels is an added convenience, and a layer of newspapers not only makes a handy covering for the work table, but also may be used to wrap the carcass at the end of the examination.

The external examination of a sick, live bird is the first step toward an accurate diagnosis. The symptoms displayed by the bird may help pinpoint your search for characteristic lesions. For this same reason, it is recommended that you include living birds with active symptoms when taking or sending specimens to your state poultry disease laboratory. Examination of a diseased fowl should include a check of the condition of its plumage. External parasites, such as lice or the grey mites, may be discovered in the feathers of the head, body, and fluff surrounding the vent. (*See Page 203.*) The neck feathers of birds suffering from coryza may be stuck together with discharges from the nostrils and eyes. Pullet disease, diarrhea, and vent gleet are among the conditions that may cause the feathers around the vent to become caked with excrement or with chalk-like deposits.

Killing a sick bird or cull should be done by dislocating the head at the neck. Dislocation, if properly carried out, will prevent the spilling of blood because the hemorrhaging from the ruptured vessels remains under the skin of the neck. First grasp the bird's head so that it rests in the hollow formed by the thumb and forefinger of the right hand. The palm of the hand should push against the back of the bird's head. Then grasp both legs in the left hand, holding the hand near your left hip. Stretch the head in a downward direction until the neck separates from its connection to the base of the skull. To facilitate the process, hold the bird's head at a right angle to the neck when the stretching motion is made. At the point of separation, the bird will flap its wings violently. As soon as the separation is felt the pressure in the

right hand should be released at once so the head will not be pulled away from the body.

Internal examination. Though your system need not observe the order that follows, all organs and tissues should be checked closely:

1. Place the bird, breast side up, on the table. The feathers of the carcass may be wet down with water before proceeding.

2. Using a sharp knife or scissors, cut between the thigh and the body. Outward pressure applied to the legs will enable you to break the limbs away from the hip joints. This will tend to steady the carcass for further examination.

3. Cut through the skin around the abdomen. Make the opening large enough to insert two or three fingers. Then pull the skin and feathers toward the bird's head until the large white muscles of the breast are exposed.

4. Use the tin snips to cut through the muscles and fat of the abdominal wall. Continue the cut through the ribs until you have reached the joint of the wing. The breast may be laid back or removed in its entirety to reveal the abdominal and thoracic organs. Additional dissection over the chest and neck will expose the crop, trachea, syrinx, and esophagus.

5. The relative position, color, and shape of the organs should be carefully observed. Pages 138 to 145 describe the normal position and appearance of the internal organs of a healthy bird. Chart 15 describes typical changes and lesions associated with the various diseases.

6. Remove the intestines carefully from the body cavity. Grasp the last portion of the intestinal tract with the dissecting forceps and cut the tissues away from their connection at the cloaca. Leave the upper part anchored to the gizzard and unravel the loops of intestine using gentle traction and a few well-directed snips of the scissors. Then cut the intestines free at their juncture with the gizzard. If worms are suspected, the intestines may be laid open by running the blunt pointed scissors through the entire length of the intestines. (*See Page 200.*)

The large and small intestines and the pancreas, liver, and spleen will often have lesions that suggest the cause of the bird's illness or death. In Chart 15 are listed the parts of the digestive tract and the liver, spleen, and pancreas and some of the important disease changes that may be encountered in a post-mortem examination.

7. Remove the gizzard and proventriculus. Trace the system back through the esophagus and crop to the opening into the mouth. The gizzard, proventriculus, and crop may be opened and examined for evidence of parasites or mold growth. Use the tin snips to cut through the tough muscles of the gizzard. (The muscles, horny lining, and grit will dull the sharpest of knives or scissors.)

One common condition of fowl is the pendulous or impacted crop. (*See Page 181.*) The abnormal swelling occasionally may be caused by paralysis

associated with the avian leukosis complex, but more often results from impaction with coarse grasses. "Sour crop" may be brought on by parasitic invasion, infection, or chemical irritation. Nails or other sharp bits of hardware protruding through the crop wall sometimes may cause the death of a bird. Needless to say, such objects should not be placed where they may be reached by birds seeking new adventures in dining.

The gizzard rarely is affected by disease. Impactions and the presence of wire, nails, or other foreign bodies are not uncommon and may cause digestive disturbances and even death. Erosion of the gizzard lining has been traced to deficiencies in the diet. Gizzard worms sometimes may be found in the tough inner lining.

Ulceration, or open sores, in the proventriculus may be caused by parasites. (*See Page 194, Trichomoniasis.*) Impactions may occur, but they are usually secondary to abnormal conditions found in the nearby gizzard or crop.

8. With the digestive system and accessory organs removed from the body cavity, the oviduct and ovaries may be seen. Many adult birds and pullets suffer from disorders of the reproductive system. The ovaries may be dark and misshapen from pullorum disease, or they may be swollen with cancerous growths. The oviduct or cloaca may become impacted with unabsorbed yolks or a large, fully formed egg. A peritonitis caused by the yolk material in the abdominal cavity may bring on the distress and eventual death of a bird.

9. The kidneys and ureters may be observed when the oviduct and yolks have been cut from the body wall. The tissues may show the growth of cancer cells or reveal the typical chalky urates associated with pullet disease.

10. The final portion of the carcass to examine is the respiratory system. Starting with the lungs, check for aspergillosis, pullorum disease, and other infections that localize in these tissues. (*See Diagnostic Chart for description of lesions, with page references.*) Chronic respiratory disease may cause the lungs and nearby air sacs to be covered with a thick yellow exudate. The system should be traced back to the syrinx, trachea, and the cavity of the mouth. Thick mucus or blood-tinged plugs in the bronchi and trachea may be indicative of bronchitis, laryngotracheitis, and other allied respiratory diseases. The mouth should be examined for possible obstructions that might have interfered with the bird's breathing. The sinus cavities may be examined for signs of infection by cutting across the beak behind the nostrils. The sinuses of birds affected with coryza may be swollen and filled with pus.

11. The detection of diseased nerves associated with paralysis of the neck, wings, or legs is a difficult task. The difference between diseased and healthy nerves may be so minute that microscopic examination alone will reveal the damage. The large nerves of the body include the sciatic, brachial

CHART 15

Organ or Part	*Significant Changes*	*May Be Indicative of:*
Duodenum	Thickened gut wall; gray-white streaks on external surface	Intestinal coccidiosis (*E. acervulina*) (*Page 176*)
	Filled with mucus (See also Enteritis below)	Capillaria, roundworms, tapeworms (*Page 202*)
Pancreas	Swollen; filled with white, chalky deposits	Pullet disease (*Page 165*)
Jejunum and Ileum	Sausage-like swelling, middle third of intestine; blood-flecked mucus	Intestinal coccidiosis (*E. necatrix*) (*Page 176*)
	Lower half of intestine swollen; filled with pink mucus	Intestinal coccidiosis (*E. maxima*) (*Page 176*)
	Rectum and ceca inflamed	Intestinal coccidiosis (*E. brunetti*) (*Page 176*)
Ceca	Enlarged; filled with free blood and clots; cheesy, blood-tinged exudate	Cecal coccidiosis (*E. tenella*) (*Page 176*)
	Yellow plug; cheesy exudate	Pullorum in chicks (*Page 209*) See also paratyphoid, Page 205; blackhead, Page 164; and hexamitiasis, Page 172
	Presence of worms one-half inch long	Cecal worms (*Page 202*)
Liver	Yellow color; small gray-white spots of dead tissue; presence of white nodules	Pullorum (*Page 209*)
	Slightly swollen; light colored, cooked appearance; small, gray white spots of dead tissue	Cholera (*Page 172*)
	Swollen, yellow color; small areas of dead tissue	Pullet disease (*Page 165*); Staphylococcosis (*Page 214*)
	Swollen; mottled gray; nodules with soft, creamy centers	Big liver disease (*Page 161*)
	Swollen; large, hard nodules with gritty centers	Tuberculosis (*Page 216*)
	Grossly enlarged; greenish-bronze color; gray-white spots of dead tissue	Typhoid (*Page 218*)
	Round depressions or ulcers, yellow-green in color	Blackhead (*Page 164*)
Spleen	Swollen	Pullorum (*Page 209*); Typhoid (*Page 218*)
	Surface covered with hemorrhagic areas	Erysipelas (*Page 185*)

	Presence of hard nodules with gritty centers	Tuberculosis (*Page 216*)
	Presence of tumor-like nodules with soft centers	Big liver disease (*Page 161*)
Miscellaneous	Fluid in abdominal cavity (*ascites*)	Avian leukosis complex (*Page 161*); peritonitis (*Page 120*)
	Enteritis (general inflammation of intestinal tract) and diarrhea	Blackhead, hexamitiasis, typhoid, paratyphoid, pullorum, erysipelas, staphylococcosis, cholera, pullet disease; internal parasites; or overdose of laxative or chemicals

plexus, and vagus nerves. The *sciatic* nerve may be seen by cutting and lifting the thin, triangular muscle on the inner surface of the thigh. The two narrow nerve strands run parallel to the muscles and adjacent to one of the major blood vessels of the leg. The nerve of one leg should be compared to that of the opposite leg to help determine abnormality. The nerve should be traced back into the pelvic cavity and under the middle lobe of the kidney close to its origin in the spinal cord. A cancerous nerve may be swollen many times its normal size. Its color will be yellowish or dull gray instead of white. The pattern of cross striations seen in healthy nerves is not visible in diseased nerves. Nerves making up the *brachial plexus* enervate the muscles and other tissues of the wings. These nerves are located close to the juncture of the wing and the body. They may be enlarged and discolored in birds suffering from paralysis of the wings. (*See Plate 32.*) The *vagus nerve* runs along the neck close to the brain, enters the chest cavity, and ends in the tissues just below the heart. The heart, lungs, and various parts of the digestive system are affected when disease strikes this important nerve.

PREPARING BIRDS FOR THE LABORATORY

To derive maximum benefits from the services offered by your state poultry disease laboratories, you should be prepared to follow certain procedures. It is very possible for laboratory personnel to make mistakes in their diagnostic work. Fortunately, such mistakes are the exception rather than the rule. You can help the pathologist avoid possible error in your case by following these recommendations:

1. Bring your specimens to the laboratory in person. No one knows more about your flock and its problems than you. First-hand information given to the pathologist may supply a valuable clue as to the nature or origin of a disease. If circumstances prevent your going to the laboratory, have someone familiar with the flock and the operation of the farm represent you. *Do not ship specimens unless there is no other way to get them to the laboratory.*

2. Select three to five adult birds or five to seven baby chicks that show typical symptoms of the ailment with which you are concerned. Do not pick culls from the flock in the hope that they will show the internal lesions of the disease *unless* their symptoms are similar to those of other affected birds. If birds have died on the day the trip is to be made, take two or three along in addition to the live birds. Protect the live birds against suffocation by punching holes in the top and sides of the carton or case. An old corrugated-fiber egg case makes a handy container for live specimens. If birds must be shipped long distances, put a handful or two of wet mash at the bottom of the container.

3. Prepare a history of the flock, including the following information:

a. The number and breed of the birds in the flock and their ages.

b. The source of stock and their pullorum rating if available. The age of the birds when purchased (day-old chicks, started chicks, ready-to-lay pullets, or mature hens or cockerels).

c. The number of birds in different age groups that are showing symptoms of disease. If the symptoms you have noticed on the farm differ from those apparent at the time of your visit, discuss the differences with the veterinarian.

d. The date the symptoms first appeared and the rapidity with which they spread. If laying flocks are affected, give the percentage of egg production at the onset of disease and the egg production total at the time of your visit to the laboratory.

e. The type of feed and feeding system in use. Give the protein percentage in the mash and the ratio of mash to grain being fed. If mechanical equipment is used, give the age of the birds when the switch was made to automatic feeders and waterers.

f. Factors that may have weakened the flock's resistance to disease, including vaccination reactions, exposure to drafts, overheating or chilling (especially in brooder houses), overcrowding, moving to new quarters, deworming, caponization, debeaking, or overdosing with drugs.

g. Outline the vaccination program you follow. Give information as to the type of vaccines used (dead or live virus); method of administration (intramuscular, intraocular, intranasal, placed in water, wing-web, spray, or dust); age of all birds on the farm when vaccines are given; different types of vaccines given at one handling; number of birds treated with a 100 or 500-dose vial, and the method of storing vaccines before use.

h. Describe treatments of diseases, past and present. Give the name of the drugs used, method of administration, and their effect, if any, on the symptoms and mortality of affected birds.

i. History of previous outbreaks of disease on your farm or neighboring farms. Make note of recent visits from other poultrymen or poultry dealers that have preceded the outbreak of disease.

4. If birds must be shipped to the laboratory for examination, keep these suggestions in mind:

a. Do not ship birds, dead or alive, over the weekend. If in doubt as to delivery times, consult the nearest express office for information.

b. Enclose a stamped envelope containing the history of the flock as outlined in the paragraphs above. Be sure to print your name and address on the letter. If speed is desired, give the laboratory director permission to call your farm collect to give you the diagnosis and recommendations for treatment.

c. Ship live birds that show typical symptoms of the disease. Place them in well-ventilated crates, cases, or cartons. If dead birds are to be shipped, they must be wrapped carefully to prevent seepage. In warm weather the carcass should be put in a waterproof container and placed within a larger container that can be packed with dry ice or an ice and sawdust mixture. A decomposed carcass is of little value in diagnosing disease. Save your time and money by preparing a package that will protect the carcass against rapid spoilage.

d. If tissues from a diseased carcass are to be sent to the laboratory, they may be placed in a small container with a tight-fitting lid and filled with powdered borax or a 10 per cent solution of formalin.

Additional recommendations for handling diseased carcasses may be obtained by calling or writing the disease laboratory in your state. (*Addresses on Page 230.*)

Diagnostic Index for Diseases of Chicks and Pullets (1 to 12 weeks)

A comprehensive index of poultry disorders is presented in the following pages. The significant symptoms associated with the disease or condition are presented in the left hand column. When the symptoms of a specific disease are of a respiratory as well as a digestive nature, they will be found under both headings. The common names of the diseases are given in the middle column. The right hand column contains information that may be considered characteristic of the suspected disease. The farmer is urged to read the complete discussions (page references are given in the chart) of the diseases found in this chapter. A study of the causes, symptoms, treatment, and prevention of the diseases and parasites will be helpful to both the beginning and experienced poultry farmer.

Symptoms	*Disease*	*Diagnostic Aids*
I. RESPIRATORY SYMPTOMS (*Coughing, gasping, sneezing*)		
With nervous symptoms	Newcastle disease, *Page 195*	Rapid spread, 60-90% mortality

Symptoms	*Disease*	*Diagnostic Aids*
With *no* nervous symptoms	Bronchitis, *Page 168*	Slight gurgle or click in throat; rapid spread; mortality as high as 50% in chicks
	Aspergillosis, *Page 160*	Few birds affected; green-yellow spots in air sacs and lungs
	Pullorum, *Page 209*	Marked depression; shivering; diarrhea; mortality highest at two weeks
	Paratyphoid, *Page 205*	Similar to pullorum; mortality high at 4 days or 10 to 12 days
	Gapeworms, *Page 202*	Presence of red worms in windpipe
	Overheating, *Page 187*	All birds affected at once; rapid breathing; variable mortality
	Laryngotracheitis, *Page 191*	Rare in chicks; occasionally hits broiler operations
	Coryza, *Page 179*	Not common in chicks; wet noses, discharge from eyes
	Chronic respiratory disease, *Page 174*	Rattling cough; slow spread; low mortality; many culls
II. NERVOUS SYMPTOMS (*Tremors, lack of coordination, paralysis*)		
No respiratory symptoms	Epidemic tremors *Page 184*	Strikes few birds 10 days to 2 weeks of age
	Infectious catarrhal enteritis, *Page 172*	Watery stool; constantly seeking heat; stiff walk
	Avian Leukosis complex (fowl paralysis), *Page 161*	Seen in chicks as young as six weeks
	Encephalomalacia (Vitamin E deficiency) *Page 198*	Comparatively rare

Symptoms	*Disease*	*Diagnostic Aids*
With respiratory symptoms	Newcastle disease, *Page 195*	High mortality
III. DIGESTIVE SYMPTOMS		
Bloody diarrhea	Coccidiosis, *Page 176*	Ceca, or blind guts, swollen and filled with blood
	Hemorrhagic disease, *Page 189*	Bleeding into muscles of the body
Non-bloody diarrhea	Pullorum disease, *Page 209*	High mortality at 2 weeks of age; depression; shivering
	Paratyphoid, *Page 205*	Same as pullorum; mortality highest at 4 days or 10 to 12 days
	Infectious catarrhal enteritis, *Page 172*	Nervousness; stiff walk; rapid emaciation
	Intestinal coccidiosis, *Page 176*	Marked loss of weight; many culls; usually affects older birds
	Pullet disease, *Page 165*	May affect chicks as young as six weeks; chalk-like deposits in kidneys and pancreas
	Staphylococcosis, ("Staph" arthritis) *Page 214*	May become generalized; swollen, painful joints; variable to high mortality
	Poisoning, *Page 206*	Marked inflammation of intestines
	Rancid oil in feeding, faulty feeding practices, *Page 184*	Marked inflammation of intestines
	Roundworms, tapeworms, *Page 202*	Presence of worms in intestinal tract. Microscopic examination of feces.
	Chilling and pile-ups, *Page 51*	Congestion of lungs on autopsy
	Litter eating	Litter found in digestive tract
	Use of Epsom salts or milk flushes, *Page 184*	Over-use causes severe intestinal inflammation

Symptoms	*Disease*	*Diagnostic Aids*
	Omphalitis, *Page 193*	Navel opening fails to close
	Crop or gizzard impaction, *Page 181*	Litter, or long coarse grasses found in digestive tract
	Gizzard erosion, *Page 149*	Gizzard lining frayed, black-brown in color
IV. LAMENESS	Perosis (nutritional deficiency), *Page 199*	Bowing of legs; slipped tendon; may appear in older chicks and poults
	Rickets, *Page 198*	Deformed, soft bones; beading of ribs
	Vitamin G deficiency, *Page 198*	Curling in of toes
	Staphylococcosis, *Page 214*	Sulphur-colored diarrhea; variable mortality
	Fowl paralysis (avian leukosis complex), *Page 161*	May occasionally attack young birds; paralysis of legs, wings, and neck
V. SUDDEN, UNEXPLAINED DEATHS (*Miscellaneous conditions*)		
	Dehydration, lack of water	Tissues dry and dark; contents of intestinal tract dry
	Smothering, *Page 51*	Heavy losses at night; chicks piled in corners; congestion of lungs on autopsy
	Poisoning, *Page 206*	Inflamed intestinal tract
	Carbon monoxide poisoning, asphyxiation, *Page 207*	Stunting; nervous symptoms
	Starvation	No feed in crop or gizzard on autopsy
VI. EYE TROUBLE	Coryza, *Page 179*	Not common in baby chicks; coughing; sneezing; wet noses; eye discharge
	Conjunctivitis (ammonia burns), *Page 190*	Accumulation of ammonia gases in old litter

DIAGNOSTIC CHART FOR BIRDS 12 WEEKS OLD THROUGH MATURITY

Symptoms	*Disease*	*Diagnostic Aids*
I. RESPIRATORY SYMPTOMS (*Gasping, sneezing, coughing, running nose*)		
	Bronchitis, *Page 168*	Fast onset; rapid spread; egg production drops 10 to 70%
	Newcastle disease, *Page 195*	Fast onset, rapid spread; egg production drops 90 to 100%; some nervous symptoms
	Coryza, *Page 179*	Chronic disease; running noses; swollen facial tissues
	Laryngotracheitis, *Page 191*	Extreme difficulty in breathing; mortalities as high as 50% of flock
	Chronic respiratory disease, *Page 174*	Slow spread, persists for months; egg production drops 2 to 20%; high percentage of culls
	Vitamin A deficiency (roup), *Page 198*	Eyes swollen, filled with cheesy substance; chalk-like deposits in kidneys
	Chronic cholera infection, *Page 173*	Swollen wattles and facial tissues; green-yellow diarrhea; some deaths
	Fowl pox (wet form), *Page 207*	Cankerous deposits in mouth; scab on comb and wattles; animals suffocate
	Infectious sinusitis, *Page 212*	Swollen tissues and face
II. NERVOUS SYMPTOMS (*Lack of coordination, trembling, paralysis*)		
	Avian leukosis complex (fowl paralysis), *Page 161*	Paralysis of legs, wings, or neck; "*wry neck*"

Symptoms	*Disease*	*Diagnostic Aids*
	Newcastle disease, *Page 195*	Respiratory symptoms predominant; egg production drops to zero
	Botulism, *Page 167*	History of eating spoiled food; progressive paralysis; bird unable to hold head off the ground
	Poisoning, *Page 206*	Sudden unexplained deaths; access to rat or other poisons
	Equine encephalomyelitis, *Page 183*	In areas where the disease occurs in horses
III. LAMENESS	Avian leukosis complex (fowl paralysis), *Page 161*	Eventual and complete paralysis of leg or wing
	Bumblefoot, *Page 170*	Pus-filled swelling on ball of foot
	Staphylococcosis, *Page 214*	Hot, painful joints; sulphur-colored diarrhea; some deaths
	Scaly leg mite, *Page 203*	Swelling of scaly part of leg; presence of mite
	Avian leukosis complex (osteopetrosis), *Page 161*	Thickening of leg bone; only one bird affected at a time
	Gout, *Page 187*	Chalk-like deposits in joints and internal organs
	Rickets, *Page 198*	Bones and beak soft; beading of ribs; not common in birds older than 10 weeks
	Perosis (nutritional deficiency), *Page 199*	Swelling of joint; bowing of legs; walk on hock; found mostly in younger birds
IV. SKIN AND FEATHER CONDITIONS	Fowl pox, *Page 207*	Wart-like scabs on unfeathered parts of body
	External parasites (lice, mites, ticks), *Page 203*	Birds droopy, anemic; drop in feed consumption

Symptoms	*Disease*	*Diagnostic Aids*
	Favus, *Page 186*	Unfeathered head parts look like they are sprinkled with flour
V. DIGESTIVE SYMPTOMS (*Diarrhea, gradual emaciation*)	Chronic typhoid, *Page 218*	Positive for pullorum agglutination tests, swollen spleen; occasional deaths
	Chronic cholera, *Page 172*	Swollen, hot wattles; resembles infectious coryza
	Chronic pullorum, *Page 209*	Reaction to agglutination tests; occasional deaths
	Staphylococcosis, *Page 214*	Swollen, inflamed joints
	Intestinal coccidiosis, *Page 176*	Diarrhea; loss of appetite, emaciation
	Internal parasites, *Page 202*	
	Avian leukosis complex (big liver disease), *Page 161*	Some birds develop "water bellies"
	Blackhead (mostly in turkeys), *Page 164*	Affects all ages; sulphur-colored droppings; blackened head parts; lesions in ceca and liver
	Tuberculosis, *Page 216*	Birds "go light" when they are one year or older; typical tubercle formation seen on autopsy
	Pullet disease, *Page 165*	Hits birds in their prime; gout-like deposits in kidneys, ureters, pancreas; comb turns blue
VI. SUDDEN, UNEXPLAINED DEATHS	Pullet disease, *Page 165*	Hits pullets in early production or about to lay; comb turns blue
	Cholera, *Page 172*	Many birds die suddenly; yellow-green diarrhea; hot, swollen wattles

Symptoms	*Disease*	*Diagnostic Aids*
	Erysipelas (turkeys), *Page 185*	Yellow diarrhea; snood and caruncle are swollen and have purple tinge
	Laryngotracheitis, *Page 191*	Extremely difficult breathing; respiratory ailment; birds die of suffocation
	Typhoid, *Page 218*	Bronze-mahogany color to liver; comb and wattles pale
	Staphylococcosis, *Page 214*	Swollen, inflamed joints; no symptoms in some cases
	Poisons, *Page 206*	History of access to poisonous material

ASPERGILLOSIS

Brooder Pneumonia, Fungus Pneumonia

Aspergillosis is a fungus infection, primarily of young chicks, characterized by the formation of caseous nodules in the lungs and air sacs. The disease is caused by the inhaling of spores of the fungus, *Aspergillus fumigatus*, found in moldy litter and feed.

Symptoms: The number of affected chicks may vary from a few isolated cases to a large percentage of the brood. Gasping and difficult, croupy breathing are common symptoms. They are accompanied by drowsiness, lack of appetite, increased thirst, and eventual emaciation and death. Mortality may be high if the birds have been weakened by other infections. Aspergillosis sometimes causes a severe inflammation of the tissues of the eye. A cheesy pellet may be seen under the third eyelid.

Diagnosis: The respiratory symptoms may resemble those of infectious bronchitis or Newcastle disease. However, the absence of the typical rattle or click of bronchitis and the lack of the nervous symptoms of Newcastle disease differentiate between the conditions. Bacterial examination will eliminate the possibility of pullorum infection. On post-mortem examination the fungus growths or yellowish nodules may be seen in the windpipe and air passages of the lungs. The air sacs in the abdominal and thoracic cavities may be covered with a thick yellow exudate. These growths are further characterized by a fur-like down with a yellow-green tint—a certain indication of aspergillosis. In some birds the nodules are small and the fungus

growths are invisible to the naked eye. Identification then must be made on microscopic examination or culture of the causative organism.

Treatment: There is no known treatment for aspergillosis. Chicks suffering from the disease should be killed and the carcasses burned or buried. Moldy litter or feed should be removed from the premises and destroyed.

Prevention: Chicks in good health usually can withstand natural exposure. If they are in a weakened condition or exposed to heavy concentrations of the fungus spores, they will rapidly succumb to the infection. Moldy feeds and litter are a potential source of infection. Avoid their use, especially around young chicks.

AVIAN LEUKOSIS COMPLEX

Fowl Paralysis, Lymphomatosis, Big Liver Disease, Leukemia, Range Paralysis, Neurolymphomatosis, Ocular Lymphomatosis, Gray Eye, Osteopetrosis, Marble Bone, Leukosis

A complex group of transmissible, cancer-like diseases of chickens. The condition assumes many different forms and is capable of striking and destroying any organ or part of the body. Avian leukosis complex in its various forms causes the poultry farmer greater losses than any other single poultry ailment.

Cause: The infective agent is believed to be a filtrable virus. The disease affects birds of all ages, but is seen most often in mature fowl. It is not uncommon, however, to find the condition in pullet replacements or broiler chicks as young as six weeks of age. The avian leukosis complex exists in five general forms, each producing its own characteristic lesions and symptoms. In spite of the various forms taken, however, evidence still indicates that a single virus is responsible for all types of the disease. The A.L.C. virus may be carried in the body discharges of infected adult birds. Transmission of the virus through the egg is also possible. Baby chicks harboring the virus may spread the disease to susceptible members of the brood. Outward symptoms may not become apparent for two to four months following the hatching of infected chicks or their initial exposure to materials containing the infective virus. Individual resistance may be passed by breeding hens and cockerels to their offspring.

Nerve or Neural Type: (*Neural Lymphomatosis*) This type attacks the nervous system and is commonly known as *range paralysis* or *fowl paralysis*. The various paralytic symptoms are commonly seen just before the birds are placed in laying houses, when they are from four to five months old. Most frequently, paralysis of the legs, wings, or neck is observed. In addition, there may be a sour crop, wry neck, and occasionally, general incoordination of the body. Birds with leg paralysis often assume a characteristic straddling position with one leg extended forward and one backward, as

though the chicken were doing the split. (*See Plate 34.*) Birds may show lameness, drooping of one or both wings, and breathing difficulty.

Diagnosis: Nerves supplying the paralyzed parts may be enlarged and have a slight yellowish discoloration. Frequently, however, no lesions may be seen with the naked eye; microscopic examination of the nerves is required. (*See Plate 32.*)

Limberneck, Newcastle disease, polyneuritis, perosis, rickets, curly toe paralysis, and avian encephalomyelitis may sometimes show the same symptoms as those mentioned above. These, however, affect many birds at the same time, but fowl paralysis selects its victims singly. A differential diagnosis should be made by a trained poultry pathologist.

Eye Type: (*Ocular Lymphomatosis, Gray Eye, Pearly Eye, Fish Eye*) In this form of the disease the iris of the eye (the golden-bay colored portion surrounding the pupil) turns gray-white and loses its natural luster. The pupil, which is normally round, becomes irregular in shape and is unable to contract and expand according to the intensity of light. The eyeball may bulge. Complete or partial blindness may develop after a time. Gray eye is seen most often in fowl six months of age and older. (*See Plate 35.*)

Diagnosis: The iris of a newly hatched chick is gray in color. It changes to the clear bay or orange color at approximately four months of age. Birds more than four months old showing gray irises or irregular pupils are almost certainly suffering from the ocular form of lymphomatosis.

Visceral Type: (*Visceral Lymphomatosis, Big Liver Disease*) External symptoms of this form of lymphomatosis may not always be apparent. In some cases the birds suffer a drop in egg production, go off feed, and eventually become thin and emaciated. The combs and wattles may be pale and shriveled. Loose, greenish droppings may be observed. There may be an accumulation of liquid in the body cavity that will force a change in the bird's posture and shape. The bird may walk and look a little like a duck or penguin. This condition is known as dropsy or water belly.

Diagnosis: Any of the internal organs of the chicken may be affected and have large, tumor-like masses scattered through them. Sometimes the tumors are rather small and resemble the lesions of tuberculosis. Affected organs, usually the liver, spleen, kidneys, and ovaries, are light in color and enlarged. This enlargement is particularly noticeable in the liver, which may be several times its normal size. (*See Plate 36.*)

If tuberculosis is present, the small nodules, when cut into, reveal whitish, gritty centers that may be filled with pus. Tumors caused by the avian leukosis virus are uniform in consistency and commonly have soft, yellow centers; but there is no formation of pus. If the existing disease is tuberculosis, bacteriological examination of the tissues will reveal the presence of the causative bacillus.

Bone Type: (*Osteopetrosis, Marble Bone*) This form is comparatively

rare. It is characterized by the enlargement and thickening of the shank and other bones of the body. Affected birds have a stilted, jerky gait.

Diagnosis: The thickening and hardening may be noticed in any of the long bones of the wings or feet, and in the bones of the pelvis, shoulder girdle, and occasionally the spine. The external thickening of the shank may also be caused by the scaly leg mite, but in this case the bone itself is not affected; only the scales are thickened and enlarged.

Blood Types: (*Erythroleukosis*) This rare form occurs after six months of age. The birds become thin and weak, and the comb, wattles, and legs may become an intense yellow. In advance cases the bird may be unable to stand up because of the extreme weakness. There is a drop in egg production, and diarrhea and sometimes uncontrollable bleeding from the feather follicles occur.

Diagnosis: Autopsy reveals a pale and watery blood. In addition, many organs of the body, particularly the liver, spleen, and kidneys, may be enlarged and colored a bright cherry red. The redness and the enlargement are caused by the fine blood vessels becoming choked with immature blood cells.

Treatment: There is no known treatment for any form of the avian leukosis complex. Birds showing signs of paralysis, gray eye, or other symptoms indicative of the disease, should be eliminated from the flock. Strict sanitation, uncrowded conditions, and thorough culling will help prevent some of the financial losses caused by this disease.

Prevention: Because information regarding the exact cause and transmission of this disease is still incomplete, recommendations for unqualified protection cannot be made. However, it is known that birds may be more susceptible to the disease if they are subject to poor nutrition, crowded and unsanitary environments, and parasitic infestations. A thorough cleaning of brooder, growing, and laying houses should be carried out between broods. Every effort should be made to keep the birds in the best possible health and to rear them under optimum conditions. Baby chicks exposed to the avian leukosis virus may not show symptoms of the disease for two to four months after exposure.

Isolated raising of chicks, as far from growing and adult birds as is physically possible, particularly during the first two or three months, will help prevent avian leukosis losses. The longer the period of time that segregation is carried out, the greater the chances of reducing adult mortality. Separate caretakers for growing flocks, a feasible practice on large farms, will minimize exposure to infected carrier birds. Selective breeding from resistant second-year hens has produced strains of birds more capable of withstanding attacks of the virus. Should progress along these lines continue, chicks that are resistant to all forms of the avian leukosis complex will be available eventually. In addition, reports from United States De-

though the chicken were doing the split. (*See Plate 34.*) Birds may show lameness, drooping of one or both wings, and breathing difficulty.

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Prevention: Because information regarding the exact cause and transmission of this disease is still incomplete, recommendations for unqualified protection cannot be made. However, it is known that birds may be more susceptible to the disease if they are subject to poor nutrition, crowded and unsanitary environments, and parasitic infestations. A thorough cleaning of brooder, growing, and laying houses should be carried out between broods. Every effort should be made to keep the birds in the best possible health and to rear them under optimum conditions. Baby chicks exposed to the avian leukosis virus may not show symptoms of the disease for two to four months after exposure.

Isolated raising of chicks, as far from growing and adult birds as is physically possible, particularly during the first two or three months, will help prevent avian leukosis losses. The longer the period of time that segregation is carried out, the greater the chances of reducing adult mortality. Separate caretakers for growing flocks, a feasible practice on large farms, will minimize exposure to infected carrier birds. Selective breeding from resistant second-year hens has produced strains of birds more capable of withstanding attacks of the virus. Should progress along these lines continue, chicks that are resistant to all forms of the avian leukosis complex will be available eventually. In addition, reports from United States De-

partment of Agriculture research scientists show some promise for the development of an effective vaccine to protect hens and their offspring from this dreaded poultry killer.

BLACKHEAD

Infectious Enterohepatitis, Histomoniasis

Blackhead is an infectious and highly fatal disease of turkeys, characterized by severe inflammation of the ceca (*blind gut*) and liver. The disease may affect chickens, quail, ruffed grouse, and guinea fowl as well as turkeys.

Cause: Blackhead is caused by a parasite called *Histomonas meleagridis.* Birds are infected by consuming feed or water contaminated with droppings that contain the causative organisms. The parasite also may be transmitted through the eggs of the chicken cecal worm, and it may be spread by flies that have fed on infected feces. The histomonads live in the ceca and liver. Chickens may harbor and spread the disease to turkeys without themselves showing visible symptoms of the infection.

Symptoms: The disease usually strikes poults ten weeks of age and older, but it may affect turkeys of all ages. Chickens six to 16 weeks of age may get the disease. Infected birds show a loss of appetite and appear droopy and weak. Their feathers are ruffled and unkempt. There may be a blackening of the head parts. (There are other diseases that also produce this discoloration.) One symptom that often is highly indicative of blackhead is the passage of loose, sulfur-colored droppings. The birds lose weight rapidly and eventually die. Mortalities may be as great as 100 per cent.

Diagnosis: The lesions of blackhead are confined to the ceca and the liver. (*See Plate 37.*) The cecal tubes are enlarged, thickened, and filled with a foul smelling, yellow or green mass that has a cheese-like consistency. This exudate may be spotted with dried blood. The surface of the liver is marked by yellowish-green, circular patches of diseased tissue in the form of shallow depressions or ulcers. In addition, there may be evidence of peritonitis, an inflammatory condition of the intestinal covering and lining of the abdominal cavity.

Blackhead Control: A cecal worm-control program and strict sanitary measures will help prevent blackhead losses. In heavily infested areas, turkeys should be wormed periodically with phenothiazine or nicotine-sulfate preparations. Phenothiazine usually is added to the regular mash at the rate of 1 pound of the drug to each 100 pounds of feed. Birds should be moved to clean ground one to two days after treatment to prevent reinfestation with expelled worms. A weekly feeding of the deworming drug may be given at the rate of 1 pound for each 500 birds. The flock must be protected from the infections contained in contaminated feed and water.

There is no drug that will *cure* blackhead once the parasites have reached the liver. "Enheptin," has shown great promise in *controlling* and *preventing*

the infection. The recommended preventive dose is 0.05 per cent of an all-mash ration. The preventive feeding is usually started one to two weeks before the ordinary blackhead losses are encountered. The medicated mash is fed continuously until two weeks before the turkeys are marketed. Should an outbreak occur in untreated flocks, the drug is fed at the control level, or 0.1 per cent of the all-mash rations, for two weeks. If losses continue after this period, the dosage is reduced to 0.05 per cent. To facilitate the mixing of such a low percentage of the drug, manufacturers prepare a 20 per cent mixture, which is then added at the rate of one-half pound to 200 pounds of mash for the preventive level. When the drug is prepared for the control level, one-half pound of the mixture is added to 100 pounds of mash. A soluble form of "enheptin" is also available for medicating drinking water for controlling and preventing blackhead losses. "Enheptin," or any similar drug, will not help birds in the advanced stages of infection.

Blackhead is far easier to prevent through proper management and sanitation than it is to control once the infection has started. The following measures are worth considering:

1. Rear poults on raised wire or slatted platforms.
2. Segregate young, growing poults from older stock.
3. Avoid mixing chicken and turkey enterprises; if chickens are on the premises, keep them away from the turkeys.
4. Minimize fly and mosquito populations through continual use of insecticides.
5. Reduce the concentration of harmful bacteria and parasites.
6. Place feed and water containers on wire platforms and protect them from fecal contamination. Feed and water containers represent a constant hazard for the perpetuation of filth-borne infections.
7. Rotate ranges as often as possible. Change grazing land for growing flocks at least once a month if ranges are known to be infected.
8. Do not spread chicken or turkey manure on grounds to be used by either of these birds. A well-formed compost heap will keep the parasites and their eggs at a minimum.

BLUE COMB DISEASE

Pullet Disease, Avian Monocytosis, Mud Fever, Entero-Nephritis, Non-Specific-Enteritis

Blue comb disease is an obscure disorder affecting both young and mature stock. It has been reported in both chicken and turkey flocks. Blue comb is primarily found in ready-to-lay pullets or birds in the early stages of egg production. It has been observed in chicks as young as four or five weeks of age. The exact cause of the condition is not known, though some evidence points to a virus as the possible source of infection.

Symptoms: Blue comb is encountered most commonly during the late summer and early fall, especially after hot weather spells. Few outbreaks occur after the first killing frost. Affected birds, often the healthiest, best-nourished members of the flock, may suddenly appear depressed and listless. They suffer a marked and rapid loss of appetite and an increased thirst. A profuse, green-colored diarrhea usually is present. Darkening of the head parts to a dark red or bluish color gives rise to the descriptive term "blue comb." A severe drop in egg production and a rapid loss of weight is common. As much as 50 to 70 per cent of the flock may be affected at one time. Mortality is variable, the average being 5 per cent. Losses rarely exceed 20 per cent of the sick members of the flock. Outbreaks subside in from one to three weeks, but egg production may take longer to return to normal.

Diagnosis: Blue comb disease is often diagnosed on the basis of the symptoms described above, *and on the complete absence of post-mortem lesions.* A laboratory examination will eliminate the possibility of acute intestinal coccidiosis, cholera, typhoid, pullorum, or virus infections. In some cases autopsy will show an enlarged, yellow liver and swelling of the kidneys and pancreas. The kidneys and pancreas may be marked with chalky, white urate deposits. The ureters (the tubes leading from the kidneys to the cloaca) may be filled with the white urates. Breast muscles may be pale, resembling the flesh of cooked fish. The carcasses of birds dying from pullet disease usually are in excellent condition.

Treatment: Blue comb disease is unique in one respect. Although veterinary pathologists have yet to find the exact cause of the condition, they are able to recommend several successful treatments for it. The disorder may be corrected with molasses, potassium chloride, or antibiotics administered in the feed or drinking water. The molasses may be given as a mash mixture containing 40-per-cent bran and molasses. (Many feed mills supply a pre-mixed molasses preparation.) The treated mash is given to the ailing flock every other day for seven days. Potassium chloride, in the form of commercial muriate of potash, is added to the drinking water at the rate of 1 tablespoonful to each gallon of water. The treated water should be placed in front of the birds for at least one week. The muriate of potash may then be added to the diet at the rate of 1 and one-half pounds for every 100 pounds of mash and fed for an additional ten days. Scratch feedings should be reduced or eliminated during the convalescent period. A third method consists of adding molasses to the drinking water at the rate of 1 pint for every 4 gallons of water; this method is continued for seven days, or until the birds show signs of improvement.

Prompt use of terramycin, aureomycin, and other antibiotics in the feed or water will help reduce losses from blue comb disease. Feeds containing from 40 to 100 grams of the antibiotic to each ton of mash may be used.

Because of the small quantity of the drug that must be uniformly distributed throughout the feed, most farmers purchase pre-mixed antibiotic mashes. Antibiotics are also effective when placed in drinking water. Care of flocks affected with blue comb should include a constant supply of fresh water and good ventilation of quarters. A comfortable environment in growing and laying pens will help hasten recovery time.

Prevention: To relieve the extra strain associated with approaching sexual maturity, pullets should receive inoculations (in areas where vaccination against virus diseases is advocated) well in advance of the beginning of egg production. The last vaccination should be given when the birds are not more than 14 to 16 weeks old. Making certain that pullets do not get too fat or have excessive grain during the summer and fall months is considered a valuable preventive measure. At the first sign of the disease start the molasses, potash, or antibiotic treatment. Low-level feedings of the antibiotics (25 to 50 grams per ton of mash) may be used to help prevent outbreaks of blue comb disease.

BOTULISM

Limberneck, "Food Poisoning"

A non-infectious disease affecting chickens and ducks and characterized by a progressive, muscular paralysis. When the neck muscles are paralyzed and the bird cannot control the movement of its head or neck, the condition is often called limberneck.

Cause: The actual cause of botulism is a poison produced by the bacteria, *Clostridium botulinum*, that grow in spoiled foods or decaying meat. Canned foods—such as string beans, spinach, corn, sausage, meats, and fish —which have been insufficiently heated when canned, are particularly good mediums for the growth of the botulinum bacteria. Maggots that feed on spoiled or contaminated meat ingest the toxin, or are covered with it, and may produce the symptoms of food poisoning in birds that eat the maggots.

Symptoms: Symptoms may appear as early as a few hours after the poisoned food has been eaten. Most commonly the first signs are weakness, sleepiness, lack of appetite, difficulty in swallowing, and progressive paralysis of the legs, wings, and neck. The head drops and the bird is unable to raise or control it. The bird is unsteady on its feet and eventually becomes completely paralyzed. The feathers become loose and drop out easily when the bird is handled. Death usually follows within a few hours after the onset of symptoms.

Diagnosis: Few types of poisoning will cause symptoms similar to those of botulism. The paralysis of the neck, legs, and wings, all of which may be moved in any direction without offering resistance, is particularly characteristic. In some cases a large number of maggots will be found in the bird's intestinal tract.

Treatment: Birds that have been exposed to the suspected feed, but that have not yet shown symptoms, should be given as much of a wet bran mash as they will eat in one hour. The mash should contain 1 pound of Epsom salts for each 75 to 100 birds. Feed the laxative once a day for two or three days. The Epsom salts also may be placed in the drinking water at the rate of 1 pound for every 100 birds. Individual birds may be given one-half teaspoonful of Epsom salts or 3 to 4 teaspoonfuls of mineral or castor oil.

Prevention: Avoid feeding any spoiled food, particularly canned goods, to the flock. Decomposed meat, poultry carcasses, and other dead animals should be burned or buried and not left where they might be accessible to the birds.

INFECTIOUS BRONCHITIS

Gasping Disease

An acute, highly contagious, respiratory disease of young chicks, growing birds, and laying hens. The causative agent, a filtrable virus, is spread by way of discharges from the nose and throat. Recovered birds may transmit the infective virus for 30 days following an attack. Bronchitis is most apt to occur in flocks that have been weakened by exposure to drafts, chills, excessive moisture, overcrowding, faulty feeds or feeding practices, poor ventilation, and sudden, extreme changes in weather.

Symptoms in Chicks: Bronchitis symptoms come on suddenly and spread rapidly throughout the brood. The chicks sneeze, gasp, cough, and otherwise show signs of difficult breathing. They have a peculiar, hoarse chirp. A gurgling noise or mucous click, known as a *tracheal rale,* may be heard if the bird is held close to the ear. The sound is more noticeable when the chick is excited and breathing rapidly. Other signs of bronchitis may be *a slight nasal discharge and watery eyes,* loss of appetite, and marked depression. Mortality may vary from 5 to 75 per cent of the brood. Recovered birds usually are immune to further attacks. The disease runs its course in from one to two weeks.

Symptoms in Adult Birds: Gasping, sneezing, tracheal rales, and other signs of respiratory difficulty are observed in growing and adult birds. *Nasal discharges are usually absent.* The disease is characterized by its *sudden onset, rapid spread, and relatively short duration.* Attacks are over in from one to two weeks, but abnormal egg production may continue for longer periods. Mortality may vary from none at all to 2 per cent. Should chronic respiratory disease affect the weakened birds, recovery may be delayed. And the number of deaths and culls may be increased. Laying birds suffer a sudden drop in egg production ranging from 10 to 75 per cent of normal. When production is resumed in four to six weeks, many of the eggs will be soft-shelled, misshapen, shell-less, and of poor internal quality. A higher percentage of internal layers may be found in flocks that have

recovered from bronchitis. An internal layer may seem to be perfectly healthy, but eventually will develop a peritonitis and die.

Birds may remain as carriers of the bronchitis virus for four to six weeks after their recovery.

Diagnosis: Newcastle disease, laryngotracheitis, coryza, and chronic respiratory disease may produce symptoms that are similar to those of bronchitis. The Diagnostic Chart on Page 197 will serve as a tentative guide to recognizing this disease. Laboratory procedures are usually required to make a positive diagnosis of respiratory diseases. Your state poultry disease laboratory may include suggestions for establishing a disease control program along with providing an accurate diagnosis.

Treatment: Isolation of affected birds and patient nursing still constitute the best approach to bronchitis treatment. The birds should be housed in warm, dry draft-free quarters. Increased food consumption may shorten recovery time. To stimulate the bird's appetite, feed them hot, wet mashes or pellets three or four times a day. Feeds containing antibiotics will serve to whet appetites and reduce the possibility of bacterial complications. Medicated sprays or ultra-violet lamps have little or no effect on the outcome of the disease. Barring complications, recoveries should take place in one or two weeks, with or without medication. But a little extra nursing will go a long way in bringing the birds back to normal.

Because poor quality eggs are laid for some time following bronchitis attacks, it is sometimes wise to dispose of affected layers. Pullet replacements may be vaccinated against bronchitis. Do not initiate a depopulation program without first securing a laboratory diagnosis and consulting your veterinarian or the poultry pathologist at the state college.

Prevention: Buy day-old chicks as replacement stock, if possible, and raise them to maturity yourself. Do not allow contact between susceptible chicks and birds that have recovered from bronchitis. They may carry and transmit the virus for 30 days or more after the symptoms have disappeared. Carefully clean and disinfect brooder houses and equipment at least one week before new chicks arrive. One pound of lye in 5 and one-half gallons of hot water makes an effective disinfectant and cleansing agent. This should be followed by a spraying with a 3 per cent saponified cresol or a solution of quaternary ammonium compound. Formaldehyde fumigation and steam disinfection may be used to advantage, particularly in hatcheries or where battery brooders are used. Check ventilation and brooder temperatures carefully. Avoid overcrowding birds. Protect them from drafts and excessive dampness. Proper management will save more chicks than a reliance on "cure all" drugs.

Vaccination: Vaccination against bronchitis is a routine procedure in many sections of the country. Immunity may be gotten in three ways: 1) Recovery from a natural attack; 2) controlled, "hot" virus inoculation of

young pullets; and 3) vaccination with a live, attenuated or modified strain of the virus. All three methods will confer immunity lasting from six months to a year or longer.

During the summer months while pullets are still in growing pens or on the range, vaccination teams from state colleges and universities, at the invitation of interested farmers, visit the flocks and inoculate 5 per cent or more of the susceptible pullets with a potent strain of the bronchitis virus. The birds are between ten and 18 weeks of age at this time. The infection spreads rapidly to the remainder of the birds on range until all have acquired the "controlled" infection. Inoculation is carried out when the birds are in the peak of condition. Recoveries usually occur in ten to 12 days after inoculation. A subsequent, solid immunity is conferred on the entire exposed flock, and recovered birds will not come down with bronchitis during the course of the laying year. If your farm is located in a state where this system of vaccination is practiced, call your county agent, state livestock officials, or state poultry pathologists for information regarding the procedure. (*See Plate 38.*) Pox and laryngotracheitis inoculations should be completed at least four weeks before the flock is vaccinated for bronchitis. (*See also Vaccination Charts, Page 220.*)

BUMBLEFOOT

An inflammatory and pus-filled swelling in the ball of the foot and in and around the toes. The abscessed tissues produce symptoms of lameness in the bird. Bumblefoot is primarily a local infection. Should the bacteria gain entrance to the blood stream, however, a generalized infection or blood poisoning may result.

Cause: Either of two bacteria, *Staphylococcus aureus,* or *Staphylococcus albus,* may be responsible for bumblefoot. Bruises and cuts or sharp, dirty roosts and poorly covered floors may predispose the birds to sporadic outbreaks of the condition. Punctures of the skin by nails, glass, sharp splinters, or protruding portions of roost wire may also introduce the infection.

Treatment: Bumblefoot abscesses may be cut into with a sharp knife or scissors to remove the red fluid or the yellow, cheese-like exudate. Make the incision on the upper side of the infection. Paint the wound with tincture of iodine and confine the bird to a small pen or coop until recovery is assured. Healing will be hastened if the wound is cleaned daily, fresh iodine applied, and the leg covered with a clean bandage. Sulfathiazole powder may be used in the wound instead of iodine. Treatment of bumblefoot is advocated for birds still in production or for those having exceptional value as breeders. If the hen or pullet is no longer a profitable boarder, immediate slaughter is advised.

Prevention: Floors should be covered with at least 6 inches of a suitable

litter. Check roosts and nail down jagged wire edges. Roost edges should not be sharp and should be free of uneven projections and splinters. Runs that are too gravelly and may be hard on the birds' feet should not be used.

CANNIBALISM

This vice includes vent picking, toe picking, feather pulling, comb picking, and the complete disembowelment of birds, usually victims of prolapse of the oviduct. Conditions that may initiate outbreaks of cannibalism are overcrowding, overheating, shortage of feeder space, dietary deficiencies, the feeding of high energy, low fiber mash, prolonged periods of idleness, and the presence of mites or lice. Some strains of birds are by nature more cannibalistic than others.

Treatment and Prevention: Many anti-picking systems have been tried in an effort to discourage cannibalism. A résumé of the more satisfactory controls is as follows:

1. Increase salt content of the mash so that it makes up 2 per cent of the mash ration. If both grain and mash are being fed, increase the salt content to 4 per cent of the total ration.

2. Use debeaking machines to remove the tips of the beaks of offending birds. If necessary, the debeaking may be done with a penknife, cutting back three-sixteenths of an inch from the tip of the beak. Some farmers request that their baby chicks be debeaked before they are shipped from the hatchery. This practice will help control feather picking in broiler flocks. (*See Plate 39.*)

3. Use hen blinders, beak guards, or vent shields.

4. Anti-pick pastes, made up of vile tasting creosote, aloes, or pine tar mixed with a harmless red dye, are effective in controlling outbreaks of picking, particularly in young birds.

5. Red light bulbs placed in the brooder house and red paint on the brooder windows will make all objects within the house look dark. The birds will be unable to distinguish blood from other objects in the room.

6. Supplementary feedings of grass, lettuce leaves, beets, or succulent roots will keep the chicks so busy eating they will not have time to pick on their neighbors. Some men advise putting cut newspapers in the pens; the chicks scratch around the paper and their minds are diverted from the more damaging pastime of picking.

7. Reducing brooder temperatures will prevent some picking. A slightly chilled bird is better off than one that is overheated.

8. Keep the birds free of lice, mites, and other external parasites.

9. Supply adequate floor space and enough feeders and waterers to prevent excessive waiting or fighting for a place at the feed hopper or water trough.

INFECTIOUS CATARRHAL ENTERITIS

Hexamitiasis

An acute intestinal infection of young turkeys, characterized by an inflammation of the upper portion of the digestive tract.

Cause: A microscopic, protozoan parasite called *Hexamita meleagridis.* The disease is spread by the droppings of infected carrier birds, usually adult turkeys, pheasants, or quail. Young and susceptible poults will come down with typical symptoms within a few days after eating the contaminated water or feed.

Symptoms: Poults one to 12 weeks of age are most often affected. Symptoms include nervousness and a stiff, awkward walk. The poults appear ruffled and unkempt. They may continue to eat, but still suffer from a general listlessness and rapid loss of weight. A watery and somewhat foamy stool is passed. Acute attacks may result in sudden coma and death. Mortality is often highest when the infected birds are three to eight weeks old.

Diagnosis: Post-mortem examination will reveal emaciation and an inflamed intestinal tract filled with slimy mucus. Microscopic examination of the intestinal contents will establish the presence of the infective organism. It is best to bring sick poults or ones that have recently died to the laboratory for examination.

Treatment and Prevention: Favorable results may sometimes be obtained by feeding a 3 per cent dried whey mixture in a 1:2000 solution of copper sulfate. The medication is given for five to seven days, or until improvement is noted. A recurrence of symptoms, however, is not uncommon. There is some indication that terramycin, aureomycin, and other antibiotics in the feed or water may minimize losses from the infection. Increased brooder temperatures will help reduce mortality.

The key to control and prevention of this disease is improved management and sanitation. Segregate old birds and poults. Incubate and brood artificially. Minimize fecal contamination of feed and water containers by placing them on wire platforms. If exercise yards are used, they should be constructed of cement to make for easier cleaning. The use of wire runs or pens is a decided improvement over other, more conventional methods. Reduce the fly population as much as possible.

FOWL CHOLERA

An infectious and highly contagious disease (or septicemia) characterized by elevated temperatures, bleeding into the internal tissues, and often a high mortality rate. Cholera affects chickens, turkeys, ducks, and geese, and may be encountered in pigeons, pheasants, and other wild birds. The chronic form of the disease may persist for months on infected farms.

Cause: A bacteria, *Pasteurella avicida.* The infective bacteria are found in the bowel and nasal discharges of infected fowl. These contaminate sources of feed and water and help spread the disease. Cholera outbreaks are most apt to occur when birds are overcrowded, exposed to drafts, chills, excessive moisture, or subjected to a breakdown in sanitation and proper management.

Symptoms: In acute infections the onset of the disease may be so rapid that the first indication of any trouble will be the discovery of dead birds. Mortality may run as high as 90 per cent of the affected flock. The less acute forms of the disease may produce many symptoms, of which the following are the more or less common ones: a greenish-yellow diarrhea; refusal of food, but an increased thirst; lameness and swelling of the wing and leg joints; swollen wattles or caruncles that are hot to the touch and apparently painful; a purple discoloration of the comb, wattles, and other head parts; difficult breathing and a marked listlessness. The birds may be very reluctant to move at all. Chronically affected birds lose weight rapidly. They may remain in a depressed state for a week or two before succumbing to the infection. In some chronic outbreaks, mortality may be low. The survivors harbor the cholera bacteria in their respiratory tracts and in their swollen wattles. The disease may flare up and assume its acute form should the flock be subjected to poor environmental conditions.

Diagnosis: In highly acute cases nothing out of the ordinary will be found on post-mortem examination. In some carcasses red hemorrhagic areas may be found in the lungs and intestines. The fatty tissues may be covered with small, pin-point hemorrhages. The first loop of the intestine may be red and inflamed and filled with blood. The ovaries may be ruptured and small pieces *of yolk material, which look hardboiled, may be scattered throughout the* body cavity. The liver is enlarged, has a cooked appearance, and breaks apart easily when handled. It may be speckled with small gray spots of dead tissue. The spleen is *not* enlarged. The sac around the heart (*pericardium*) is filled with small, white flakes floating in a straw-colored fluid. The surface and fat at the base of the heart may be hemorrhagic. There may be a red discoloration of the breast muscles.

No other disease is characterized by such a sudden and fatal onslaught as acute cholera. Subacute and chronic cases, however, manifest themselves in a variety of symptoms and lesions. A bacteriological examination, in which the pasturella organism is isolated and identified, is the only way to establish a positive diagnosis.

Treatment: Sulfamethazine, sulfamerazine, or sulfaquinoxaline fed in the mash or placed in the drinking water are effective in reducing mortality from fowl cholera. Antibiotics and other drugs may be toxic if fed in excess of recommended levels. Directions supplied by the manufacturer should be followed exactly.

Cholera symptoms and losses may recur shortly after medication has been withdrawn.

Kill all visibly affected fowl, being careful not to spill their blood. Remove at once and carefully burn or deeply bury all dead birds; they are a potent source of infection to healthy birds. (*See Plate 40.*) Clean out and replace litter in the houses. Clean and disinfect water fountains and feeders daily. Avoid future contamination of feed and water supplies. Vaccines are sometimes recommended, but they confer, at best, a short-lived immunity. They are hardly worth the time and money involved in administration. Dispose of infected flocks at the earliest possible time. It is the safest way to prevent reinfection. Wait at least 30 days before restocking the premises. A thorough job of cleaning and disinfecting should be done before the new birds arrive.

Prevention: A rigid program of sanitation is the best protection against cholera. In particular, be careful not to bring onto the farm any mature birds as replacement stock. Disinfect all quarters thoroughly before introducing new chicks. Scrub the walls, roosts, nests, food and water containers, and other equipment, with a solution of 1 pound of lye to 5 and one-half gallons of hot water. Then spray with a 3 per cent solution of saponified cresol. Steam generators are excellent for disinfecting poultry houses and equipment.

Shelters and houses for chickens or turkeys should not be built on low, wet ground that will not drain properly. Such ground provides ideal conditions for the growth of the cholera organisms.

The use of bacterins, vaccines, or serums for preventing cholera are *not* recommended.

CHRONIC RESPIRATORY DISEASE

Air Sac Infection

This insidious disease of domestic fowl, characterized by infection of the air sacs, has been reported in almost all of the major poultry-producing areas of the country.

Cause: A pleuropneumonia-like organism that is between a virus and a bacterium in size. The organism is believed identical with the one that produces infectious sinusitus in turkeys. Disease outbreaks often occur in flocks that have been weakened by exposure to poor housing conditions, overcrowding, a siege of bronchitis, coryza, Newcastle, and other diseases, or in flocks that have suffered a severe reaction to vaccination. These predisposing conditions are said to "trigger" the chronic respiratory organisms into producing their typical symptoms and lesions. Chronic respiratory disease may also be passed through the eggs to susceptible chicks. Recent studies indicate that a specific virus may be responsible for infections of the air sacs.

Symptoms: The disease comes on slowly, affecting only a few birds at a time. The symptoms may include a rattling cough, sneezing, and sniffling. A gurgling noise, or tracheal rale, is heard. Appetites decline and the birds lose weight. The condition may persist in spite of treatment. Chronic respiratory disease may affect birds as young as five to ten weeks of age. Broiler flocks especially may be hard hit. Mortality may vary from 10 to 30 per cent, or higher if complications from other infections arise. The number of culls and low grade birds may be great. When older birds are affected, mortality is negligible; but impaired egg production up to 30 per cent of normal and loss of weight is common.

Diagnosis: Chronic respiratory disease may strike chicks and adult fowl that have been immunized against Newcastle disease or bronchitis. It may follow on the heels of severe reactions to vaccination, particularly with multiple vaccinations. In contrast to bronchitis and Newcastle disease, C.R.D. spreads slowly through the flock and persists on the premises for a long time.

Post-mortem findings include the following: the air sacs may be thick, clouded, and covered with a cheesy, yellow exudate; the heart, liver and outside wall of the intestines may be coated with the thick yellow layer; and mucus may be found in the trachea, which accounts for the gurgling noise. A laboratory diagnosis should be obtained to differentiate between this disease and other respiratory ailments producing similar symptoms.

Treatment: Increase mash consumption by frequent feedings of wet mash or pellets to shorten recovery time. Cull the flock rigidly and frequently to keep financial losses at a minimum.

The role of the antibiotics in treating this disease has been widely publicized. Injections, medicated feed, and treated water have proved of some value in stimulating appetites and curbing losses from the disease. Antibiotics will *not* cure chronic respiratory disease. Properly used they may help the birds maintain normal egg production and weight gains. The drugs should be administered according to the manufacturer's directions.

Prevention: Segregation of young and old stock is of primary importance in preventing respiratory ailments. Recovered adults often harbor and transmit the infection to younger, susceptible chicks. Keep visitors who may have been in contact with diseased flocks away from your poultry operation. When the birds are being vaccinated, remember that accuracy is more important than speed. Multiple vaccinations may "trigger" chronic respiratory disease infections and should be used only under ideal conditions. Do not vaccinate birds suffering from worms, coccidiosis, or other diseases or parasites. Use only clean, deep litter for young chicks. Compost litters may give off strong ammonia fumes that are irritating to the respiratory tract. Old litter also may harbor infective organisms in numbers large enough to overpower the birds' natural resistance to infection.

COCCIDIOSIS

An invasion of the intestinal tract and ceca of domestic fowl by microscopic, one-celled parasites called protozoa.

The infective eggs of these parasites depend on filth, warmth, and moisture for their existence. It is difficult for coccidiosis to gain a stronghold if sanitation and good management prevail. The disease is transmitted from bird to bird through infected droppings that contaminate litter or feed and water. Coccidiosis in chickens cannot be transmitted to turkeys or other domestic animals. (*See Figure 18.*)

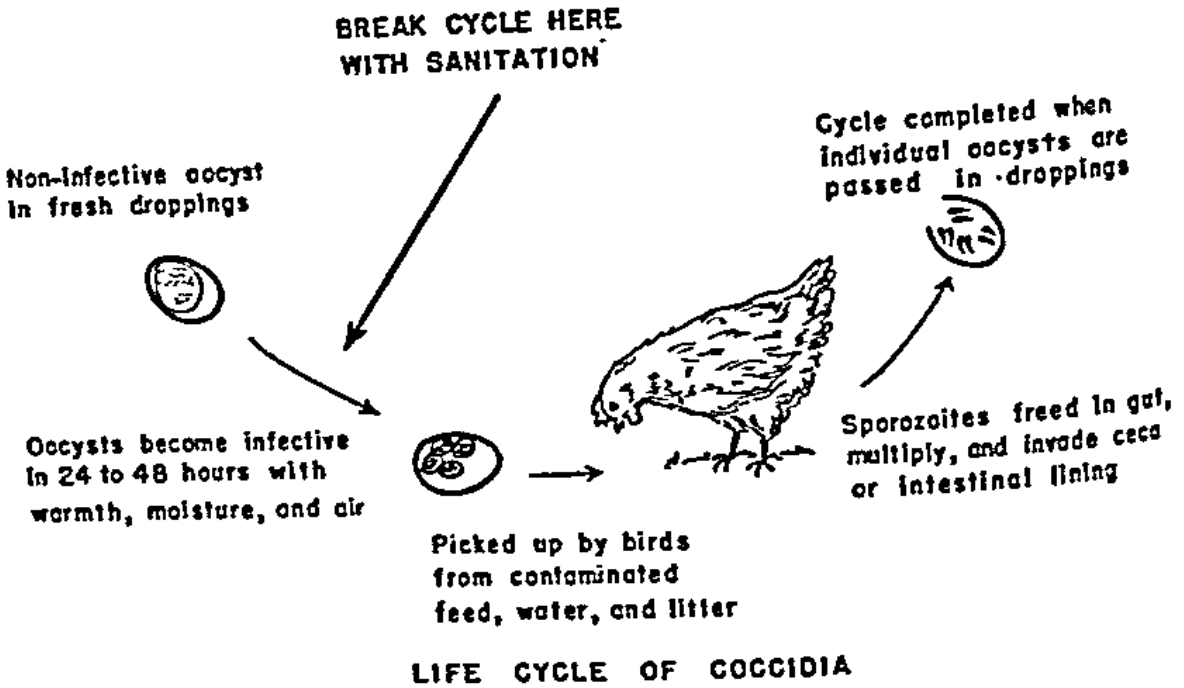

Fig. 18. Coccidiosis, a costly disease of chickens and turkeys, is more easily prevented than cured. Dry, sanitary quarters are essential to the control of this and other parasitic conditions. Low-level feedings of drugs may be used to prevent and treat outbreaks of the disease should they occur.

In chickens the disease falls into two classifications: *acute*, or cecal coccidiosis; and *chronic*, or intestinal coccidiosis. The first is primarily a disease of chicks three to six weeks old, characterized by the passing of bloody droppings and a high mortality rate. The specific causative organism is *Eimeria tenella*. The chronic or intestinal type is a disease of older fowl that results in a variable amount of damage to the intestinal tract and is accompanied by moderate to low mortality. The seven species causing chronic coccidiosis are *Eimeria necatrix* (the most prevalent), *E. maxima*, *E. acervulina*, *E. mitis*, *E. praecox*, *E. hagani*, and *E. brunetti*.

Symptoms: The symptoms vary with the type and concentration of the parasite responsible for the outbreak. Almost all birds acquire some infection during the growing or maturation periods. Recovery from a mild attack

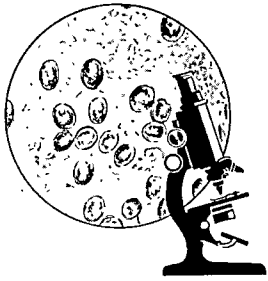

Plate 31. Microscopic examination of intestinal scrapings reveals the presence of the coccidial oocysts. A confirmed diagnosis of the disease is based on the finding of these microscopic eggs and the appearance of gross lesions. (Courtesy of the Lederle Laboratories.)

Plate 32. Marked contrast between the normal nerves in carcass A and the swollen, diseased nerves in carcass B is shown above. The brachial nerves of the wings are indicated by a; b indicates the lumbosacral nerves of the legs; and c is the vagus nerves, which go to the heart, lungs, and digestive tract. The left vagus nerve in carcass A is not exposed. (Courtesy of the United States Department of Agriculture.)

Plate 33. Veterinary poultry pathologists offer a vital service to the poultry farmer. Seek professional advice when combatting a disease or planning a vaccination program. (Courtesy of the Lederle Laboratories.)

Plate 34. The typical straddling position assumed by birds suffering from fowl paralysis. This common form of the avian leukosis complex is seen usually in pullets under six months of age. (Courtesy of the United States Department of Agriculture.)

Plate 35. "Gray eye" is a typical symptom of one type of the avian leukosis complex. The irregular pupil shown in the bird on the right is characteristic of this condition. The normal bay color of the iris has been replaced with gray. Partial or complete blindness results as the disease progresses. (Courtesy of the Lederle Laboratories.)

Plate 36. Visceral lymphomatosis. The ovaries of this pullet are riddled with cancer cells of the avian leukosis complex. The liver, spleen, kidneys, ovaries, heart, and lungs are the organs most commonly involved. (Courtesy of "Albers Egg Maker Magazine.")

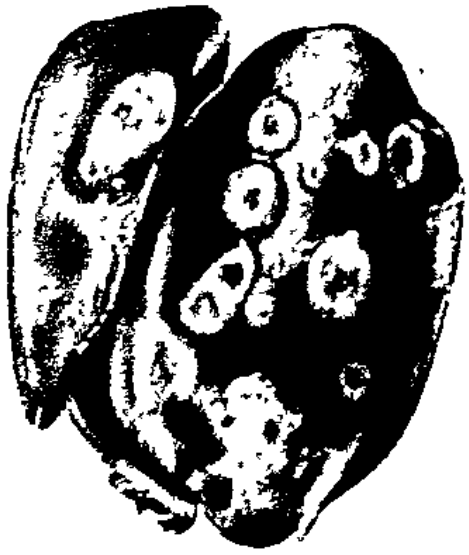

Plate 37. Liver of a turkey that has died of blackhead infection. The liver is enlarged and marked with round, ulcer-like depressions that are yellow or yellow-green in color. Although it is primarily a disease of turkeys, blackhead may also affect chickens. (Courtesy of the Lederle Laboratories.)

Plate 38 Poultry Packs may be protected against bronchitis and Newcastle disease by the spray method of vaccination. Directions of the vaccine manufacturer regarding dosage and administration should be followed closely for best results. (Courtesy of American Scientific Laboratories.)

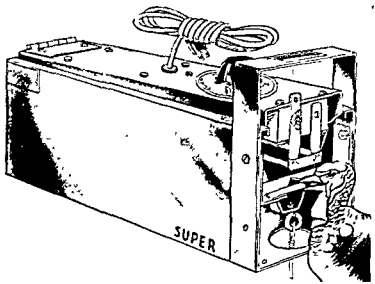

Plate 39. The removal of a portion of the upper mandible of the beak is an effective curb against cannibalism, feather picking, and similar vices. On farms where cannibalism is a serious and constant problem, the entire pullet flock may be treated when they are moved into their laying pens. The machine pictured here cauterizes as it cuts through the sensitive tissues of the beak. Bleeding is minimized and a maximum speed of operation is permitted. (Courtesy of the Lyon Rural Electric Company.)

Plate 40. Prompt disposal of dead birds discourages the breeding of flies and minimizes the spread of contagious diseases. (Courtesy of the Lederle Laboratories.)

Plate 41. The intestines of a chicken affected with acute, bloody coccidiosis. The cecal pouches, or blind guts, are swollen and filled with blood (Courtesy of the United States Department of Agriculture.)

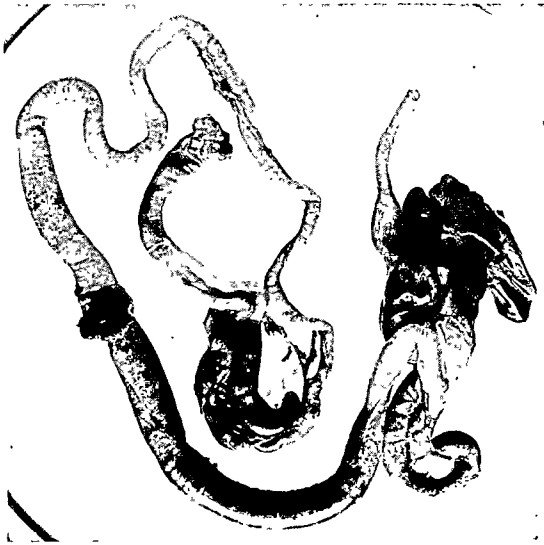

Plate 42. Viscera of a chicken showing the characteristic lesions associated with a severe case of intestinal coccidiosis (Eimeria necatrix). Note the sausage-like swelling of the middle third of the intestine.

Plate 43. A chronic case of infectious coryza. Swelling of the eyes and other facial tissues and a nasal discharge are indicative of this disease. Similar symptoms may occur in cases of nutritional roup or chronic fowl cholera. (Courtesy of the Vineland Poultry Laboratories)

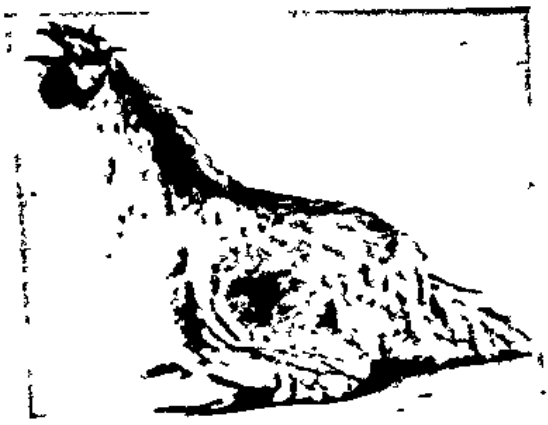

Plate 44a

Plate 44b

Plates 44a and 44b. An advanced case of fowl laryngotracheitis. The bird shows the characteristic gasping and difficult breathing. On the left, position during inspiration, on the right, during expiration. (Courtesy of the University of California, Division of Agricultural Sciences)

Plate 45. Proper cleaning of incubators helps prevent the spread of baby chick disease. High pressure steam cleaners used with detergents or caustic soda do a thorough job of cleaning and disinfecting around the hatchery and farm. (Courtesy of the Molsbary Manufacturing Company.)

Plate 46. General incoordination and paralysis may be indicative of Newcastle disease. Sneezing, gasping, and coughing usually precede the nervous symptoms. (Courtesy of the University of California, Division of Agricultural Sciences.)

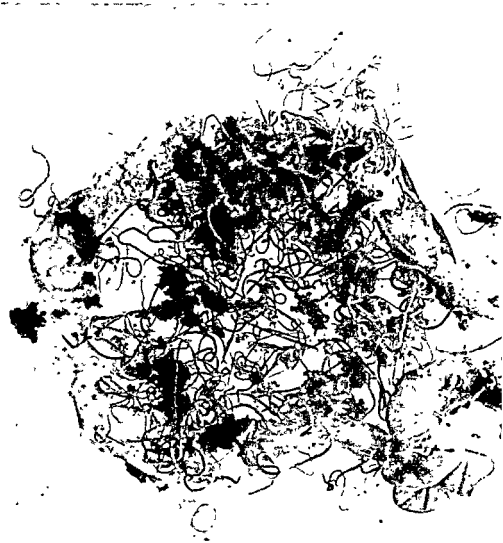

Plate 47. A severe infestation with the large intestinal roundworm. Parasitized birds are unthrifty and show a drop in egg production. (Courtesy of the United States Department of Agriculture.)

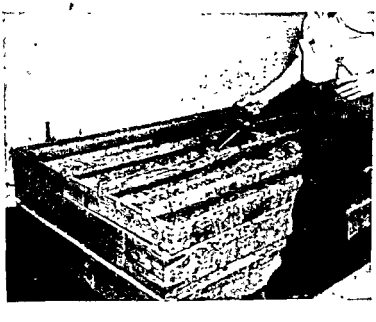

Plate 48. Nicotine sulfate or a 1 per cent wettable lindane solution applied to the roosts 30 minutes before the birds retire eliminates troublesome poultry lice and gray mites. (Courtesy of "Albers Egg Maker Magazine.")

Plate 49. Gapeworms attached to the trachea of a young turkey. The Y-shaped parasites (male and female worms joined together) cause gasping and death from suffocation or from general weakness. Birds reared off the ground are rarely affected by this parasite. (Courtesy of the United States Department of Agriculture.)

Plate 50 The black, wart-like scabs or nodules of fowl pox. The unfeathered portions of the head are most commonly affected. (Courtesy of the United States Department of Agriculture.)

Plate 51. Post-mortem appearance of a fowl with tuberculosis. Note the enlarged and spotted liver and spleen. The intestines and other organs of the body also may show grayish-white or yellowish nodules indicative of this disease. (Courtesy of the United States Department of Agriculture.)

Plate 52. Intradermic tuberculin test, a valuable aid in detecting tuberculosis in the living fowl. The testing fluid is injected (left) into one wattle and the opposite wattle is untreated. A distinct swelling of the injected tissues (right) within 48 hours is evidence of infection. (Courtesy of the United States Department of Agriculture.)

Plate 53. A sub-acute case of fowl typhoid. Note the enlarged liver and spleen. The small, gray spots on the surface of the heart are also indicative of this disease. (Courtesy of the United States Department of Agriculture.)

Plate 54. Methods of vaccination On the left is the double needle, wing-web method that can be used in administering fowl pox or Newcastle disease vaccines. On the right, the cloacal method of laryngotrachetis vaccination. The technique consists of brushing the vaccine into the mucous membranes of the cloaca. (Courtesy of the Lederle Laboratories.)

Plate 55. The cloacal membranes as they appear four to five days after vaccination for laryngotracheitis. A successful "take" is indicated by local swelling and a deep red color of the lips and mucous lining of the cloaca. (Courtesy of the University of California, Department of Agricultural Sciences.)

Plate 56. Vaccination of a turkey against fowl pox. The feather follicle or stick method of inoculation is recommended. The preferred inoculation site is the area immediately above the hock or the unfeathered skin of the upper thigh. (Courtesy of the Lederle Laboratories.)

Plate 57. A "take" following fowl pox vaccination. The swelling of the follicles and the scab formation is indicative of successful vaccination. (Courtesy of the Lederle Laboratories.)

usually results in immunity against later, more severe attacks. However, the immunity is restricted to the coccidial organism involved.

The damage done to the lining of the ceca or the intestinal tissues brings on diarrhea, bloody droppings, an abrupt drop in food consumption, and general weakness. An attack may cause permanent stunting and emaciation of chronically affected birds. Fowl that survive the disease may never mature into profitable layers or broilers. Chart 16 describes the effects of the various species of coccidia.

CHART 16

Species and Age Group	*Symptoms*	*Post-Mortem Findings*
E. tenella 3 to 6 weeks old *(Plate 41)*	Bloody droppings; loss of appetite; *ruffled feathers; droopiness;* emaciation; many deaths unless checked	Ceca (blind gut) enlarged, filled with blood or cheesy exudate
E. necatrix 3 months, older *(Plate 42)*	Loss of appetite; chronic diarrhea; *emaciation;* loss through culls; some deaths	Sausage-like swellings in middle third of intestine; mucus flecked with blood; round, opaque spots on outer surface of gut wall
E. maxima 5 to 6 months, young pullets	Blood flecked diarrhea; loss of appetite; emaciation; some deaths; disease runs short course	Lower half of intestine dilated and thickened; filled with pink mucus
E. brunetti May affect young or old	Diarrhea; emaciation; few deaths	Lower half of intestine, rectum, and ceca inflamed
E. hagani Older birds	Diarrhea; relatively harmless	Hemorrhagic areas in small intestine
E. praecox Primarily older birds	Some diarrhea; no other symptoms; relatively harmless, no deaths	Upper third of small intestine slightly inflamed
E. mitis Older birds	Diarrhea; no other symptoms; no mortality	Entire small intestine slightly inflamed
E. acervulina Older birds	Intestinal upset; some diarrhea; emaciation; chronic condition; relatively harmless	Thickening of upper portions of small intestine; white streaks visible on gut wall

Diagnosis: The passing of bloody droppings in chicks three to six weeks old is almost always diagnostic of cecal, or acute coccidiosis. Autopsy may reveal the damaged, enlarged ceca filled with free blood or a cheesy, blood-streaked core. The internal tissues are pale and bleached.

The chronic forms of intestinal coccidiosis may be diagnosed on the basis of symptoms and on the finding of typical lesions. An accurate diagnosis should be established by microscopic examination of intestinal scrapings. *(See Plates 31, 41, and 42.)*

Treatment and Control: Outbreaks of coccidiosis may be controlled and treated effectively with sulfaguanadine, sulfamethazine, sulfamerazine, sulfadiazine, sulfapyrazine, sulfaquinoxaline, nitrofurazone, and other drugs placed in the feed or water. Treatment must be started at the first sign of infestation. Regardless of the drug used, medication should not be continued beyond the recommended period. The manufacturer's directions should be followed exactly. Overdosing or careless administration of sulfa and other drugs may cause loss of appetite and *stunted growth.* Some evidence points to indiscriminate sulfa medication as the cause of hemorrhagic disease. (*See Page 189.*) Whatever drug you choose, your control program should include improvement in flock sanitation. Coccidiosis cannot exist to any appreciable extent without dampness or fecal contamination of feed and water.

Prevention: Management practices that will reduce losses from coccidiosis and other filth-borne diseases include the following:

1. Have controlled ventilation to protect the houses from excessive moisture.
2. Keep feed and water free of fecal contamination. Keep hoppers and water fountains on wire platforms. If the birds are on range, move the equipment periodically to prevent an excessive accumulation of droppings.
3. Cover roosts with a suitable wire mesh to keep the birds away from their droppings. Clean dropping boards at least once a week.
4. Avoid overcrowding the birds, especially in brooding and growing units.
5. Supply a deep, highly absorbent litter (minimum of 4 to 6 inches) and keep it dry with frequent stirrings. Adding hydrated lime at the rate of 1 pound per 4 square feet of floor space, periodic rakings, and assuring adequate ventilation will help keep the litter dry. Keep a double check on the litter around watering and feeding areas.

Be prepared to supply medication at the first sign of an outbreak, but remember that more benefit is derived from *preventive* measures than from a reliance on treatment with expensive drugs. If a strict program of sanitation cannot be executed properly, continuous low-percentage feedings of medicated mash or water may be used to minimize losses from tenella and necatrix infections. Nitrophenide, Ni Carbazin, furazolidone, nitrofurazone, sulfaquinoxaline, and other coccidiostatic drugs, used according to the manufacturer's directions, will help protect birds during their growing periods.

A vaccine for the protection of growing birds against both cecal and intestinal coccidiosis has been developed by research workers at the Alabama Polytechnic Institute. The procedure consists of exposing the flocks to a controlled infection by placing a number of coccidial oocysts in the feed of chicks when they are three days old. Thirteen days later the brood is given a low-level feeding of sulfaquinoxaline in the drinking water. The combination

of vaccine and sulfa treatment is expected to provide solid immunity against further natural attacks of the disease.

Treatment: Use sulfaquinoxaline, sulfamerazine, sulfamethazine, sulfaguanadine, or other similar drugs available from your feed dealer or veterinarian. Feeding instructions usually are supplied by the manufacturer of the drug and should be followed exactly. Coccidiostatic drugs also may be used for prevention of the disease by placing them in the feed or water according to the schedule recommended by the manufacturer.

COCCIDIOSIS IN TURKEYS

Turkeys are affected by four species of coccidia. These are *Eimeria meleagridis, E. meleagrimitis, E. gallopavonis,* and *E. adeonoeides.* Coccidiosis usually strikes poults six weeks of age and older and produces symptoms of diarrhea, ruffled feathers, droopiness, and anemia. Autopsy reveals a reddening of the intestine, which is filled with a slimy, whitish-gray mucus that may extend the entire length of the intestine. The ceca is sometimes filled with a brownish material. Diagnosis is confirmed by microscopic examination of the intestinal contents.

Treatment: Treatment consists of the use of sulfaquinoxaline, sulfamerazine, sulfamethazine, or sulfaguanadine. Avoid over-medicating with any of these drugs. Feeding instructions are usually given by the manufacturer and should be followed closely.

CORYZA

Infectious Colds, Rhinitis, Roup

An acute, contagious respiratory infection of chickens. The disease is characterized by inflammation of the mucous membranes of the eyes, sinus cavities, and upper portions of the respiratory tract.

Cause: A bacteria, *Hemophilus gallinarum.* Coryza may be complicated by secondary bacterial invaders that tend to aggravate and prolong the condition. Presence of the chronic respiratory disease organisms may result in severe infection of the air sacs.

Birds with lowered resistance are more apt to come down with coryza than those in good physical condition. The term "stress factors" is often used to describe factors that render a flock more susceptible to infection. Examples of these include: faulty nutrition, overexposure to drafts or dampness, and excessive parasitism. Other conditions that tend to wear down a bird's resistance are faulty use of compost litter, severe reactions to vaccination or hormone treatment, indiscriminate use of drugs, including worming tablets, and overcrowding on the floor and at the feed and water hoppers. Careless management practices are too often the indirect cause of poultry diseases and parasites. (*See Plate 43.*)

Symptoms: A constant and typical symptom of coryza is the discharge from one or both nostrils. The discharge, thin and watery at the onset of the disease, thickens into a foul-smelling, cheese-like substance as soon as secondary bacterial invaders enter the tissues. There may be a secretion from the eyes, and the lids may be closed. Another typical symptom is the marked inflammation and swelling of the facial tissues. One or both sides of the face, the *wattles,* and the *area around the eyes* may be swollen. The birds cough, sneeze, breathe with difficulty, and shake their heads in an effort to clear the mucus from their nasal passages. If the windpipe is affected, a rattling noise, or tracheal rale, may be heard. Loss of appetite and a gradual but persistent decrease in egg production may occur. Recovered birds are immune for a short time only and may suffer from subsequent attacks. *They may persist as carriers of the disease and represent a constant source of infection for susceptible birds.* Mortalities are low if the infection is confined to the upper regions of the respiratory tract; however, if the air sacs and lower part of the bronchi are involved, mortalities may run as high as 50 per cent. Deaths and a high percentage of cull birds may be experienced for a long period of time.

Diagnosis: Coryza may be confused with vitamin A deficiency, bronchitis, Newcastle disease, chronic cholera infections, and chronic respiratory disease. Birds in the early stages of infection showing active symptoms should be submitted to a poultry disease laboratory for examination. (*See list of addresses on Page 230.*)

Treatment: Prompt medication with sulfathiazole, or sulfamethazine for four to five days may prove effective in alleviating the symptoms. The antibiotics, such as terramycin, aureomycin, and streptomycin, also are recommended for treating coryza. They tend to reduce the symptoms and help stimulate appetites. The sulfa drugs may be placed in the feed or water. *Under no circumstances should they be used for longer periods or in higher concentrations than recommended by the manufacturer.* Overdosing may result in depressed appetites and a marked reduction in egg production. The antibiotics may be given in feed and water or they may be injected into the muscles of affected birds. Injection of 0.1 to 0.2 grams of dihydrostreptomycin has shown promise in shortening recovery time. Birds that continue to show symptoms may be injected again in five days. Oils that are rich in vitamin A and D may be given daily in wet mash or grain mixtures at the rate of 1 pint (*2,250 units of vitamin A*) for each 1,000 birds.

Regardless of the treatment used, coryza will persist on the premises unless the conditions that have predisposed to the infection are corrected. Medication must be accompanied by proper nursing and improved management practices. The use of vaccines, inhalants, or medicated sprays do little to alter the course of infectious coryza and because of the cost involved and their relative ineffectiveness, these devices are not recommended by the author.

Control of coryza is dependent on the following:

1. Stimulation of appetites. Hot, wet mashes, made by adding hot water to mash until the mixture is of a crumbly consistency, should be fed three or four times a day. Pellets may be substituted for the wet mash if desired, and antibiotics may be given in the feed or water.

2. Proper ventilation. Too little or too rapid circulation of air will aggravate respiratory infections.

3. Warmth and dryness. A chilled bird is not likely to recover from coryza.

4. Strict isolation and quarantine of affected birds. Avoid overcrowding birds. Feed and care for the infected flocks last.

5. Cull and sell or destroy birds showing signs of chronic coryza, such as swollen eyes, wattles, face, or sinuses.

6. Rear young stock separately from older birds. If possible, have separate attendants for growing and laying flocks.

7. On the advice of your veterinarian or state poultry pathologist, depopulate and thoroughly clean and disinfect the premises. The coryza organism is easily destroyed outside the living bird.

8. Avoid purchasing started or adult birds. If possible, raise your own replacement stock from day-old chicks.

CROP BOUND

Sour Crop, Pendulous Crop, Impacted Crop

An overly distended, paralyzed, and pendulous condition of the crop. Impactions may result from consuming large quantities of food or water and from swallowing coarse, indigestible matter, such as feathers, straw, or *long, fibrous grass.* The large, hanging crop may be seen after an attack of cholera or fowl paralysis. Perforation of the *gizzard* with short pieces of wire, roofing nails, or other sharp objects, or the ingestion of coarse grass may lead to impaction of the gizzard. The condition first may be noted when the crop becomes too full of feed that has backed up from the gizzard. The tendency to develop pendulous crops may be an inheritable trait; therefore affected birds should not be saved as breeders.

Symptoms: The crop is oversized, hangs downward, and is filled with sour-smelling food. The bird may show some difficulty in swallowing. A marked decline in condition, rapid emaciation, and death is the usual outcome. Impacted crops or gizzards are easily identified on *post-mortem* examination. If the gizzard is perforated, the incriminating wire or nail usually may be seen protruding from the shrunken gizzard muscles.

Treatment: Crop bound birds should be prepared for market before they lose too much weight. For the farmer who wants to try his hand at indi-

vidual treatment, the following procedure is recommended: Place 1 teaspoonful of sweet oil or a mild vinegar solution into the bird's gullet with a rubber bulb syringe. Massage the impacted mass with the bird held in an upside down position. The mass will soften and gradually can be worked out of the crop. Surgical treatment is sometimes successful in alleviating the condition. To minimize the danger of infection, it is wise to sterilize all instruments by immersing them in boiling water or a disinfectant solution of alcohol, chlorine, or quaternary ammonium compound. Remove the feathers from the skin over the distended crop wall. Make your first cut using a sharp knife, safety razor, or scalpel through the skin of the crop. Make a second incision through the crop wall approximately 1 inch long and one-half inch to the side of the opening in the overlying skin. Using a forceps, small spoon, or other suitable instrument, gently remove the impacted food mass from the crop. Flush out the crop with a warm boric acid solution. (*Use boiled water.*) The incisions in the crop and skin should be closed with a separate row of stitches. Suturing material may consist of silk or cotton thread that has been soaked in a mild disinfectant. Do not feed the bird for 12 hours following the operation. A diet consisting of wet mash or milk and raw eggs should be fed until recovery is assured. Recovered birds may be susceptible to further attacks. Immediate salvage of the bird rather than surgery is generally the best approach to the problem of an impacted or pendulous crop.

DUBBING AND CROPPING

The freezing of combs and wattles in subzero weather results in a loss of egg production in hens and a serious impairment of fertility for about a month in male birds. To prevent frost-bite in those sections of the country where temperatures go to 10 or 20 degrees below zero it is advisable to remove the combs and wattles of cockerels and pullets when they are day-old chicks. Removal of the comb is called *dubbing;* removal of the wattles is called *cropping.*

Dubbing and cropping of day-old chicks may be safely carried out by using a sharp pair of manicure or cuticle scissors. The comb and wattles are cut off close to their attachment to the head. If the operation is performed on young chicks, there is a minimum amount of bleeding. Older birds may be dubbed and cropped with sterilized tin snips or heavy shears. Bleeding may be controlled by dusting the area with iron subsulfate (*Monsel's salt*) or searing the cut surfaces of the comb with a hot iron. Do *not* use a cauterizing iron that is red or white hot. The excessive heat may result in serious damage to the bird and will tend to pull the scab away as fast as it forms.

Temporary protection against frozen combs may be obtained by coating the tissues with a thick layer of petrolatum one or two weeks before the start of the winter breeding season.

EGG BOUND

Impacted Oviduct

Pullets and adult hens may occasionally experience difficulty in passing their eggs. The trouble may be caused by an infection of the oviduct, the presence of tumors or a stricture in the reproductive tract, or the production of malformed eggs. Affected birds make frequent trips to the nest in an effort to dislodge the eggs. If straining continues without relief the oviduct tissues may prolapse through the vent. Fatal hemorrhage sometimes results from the rupturing of blood vessels. These birds usually are attacked by their penmates and are picked to death.

Treatment: Some relief may be gained by gently massaging the abdomen so that the egg is worked down toward the vent and removed by hand. One finger lubricated with petrolatum may be placed in the vent to direct the passage of the egg. If the egg is too large to pass, the shell should be punctured with a sharp object and the yolk, albumen, and shell withdrawn. Cold water may be injected with a syringe to help reduce inflammation of the tissues. The hen should be placed by herself until recovery is assured. A bird with an everted oviduct should be prepared for immediate slaughter. Although replacement of the tissues may be successful, the prolapse is apt to recur; and the bird may be picked to death before she can receive further attention.

EQUINE ENCEPHALOMYELITIS IN BIRDS

A disease of horses that occasionally infects fowl. The disease may be caused by two types of viruses, both transmissible to man. Equine encephalomyelitis affects the central nervous system and produces symptoms that are similar to those of epidemic tremors. (*See Page 184.*) As a rule, adult birds are affected rather than chicks, and pheasants seem particularly susceptible to infection. An accurate diagnosis can be made only with laboratory methods.

There is no treatment for this disease. Suspected outbreaks, especially in those areas where the condition is common in horses, should be brought to the immediate attention of your veterinarian or local public health officials. The public health agencies and state veterinary laboratories will give you all possible help in controlling the disease.

Equine encephalomyelitis may be transmitted from horses to chickens by mosquitoes, mites, flies, and other blood-sucking insects. The virus is passed from chickens back to horses by the same means. Insects may carry the disease from infected birds or horses to humans. General sanitary measures, including an insect control program, should be instituted to prevent this and other insect-borne diseases.

ENTERITIS

An inflammation of the intestinal tract evidenced by loose droppings or diarrhea. Enteritis is not a specific disease, but rather a symptom that may be caused by malnutrition, sudden changes in diet, or feeding on fibrous, moldy, sour, or otherwise spoiled food. The diarrhea may result from drinking polluted water, ingesting poisons (*arsenic, copper sulfate, phosphorus, and others*), or harboring parasites, such as coccidia, roundworms, tapeworms, or the blackhead protozoa. Infectious diseases, including tuberculosis, pullorum, and paratyphoid, may bring on the inflammation of the intestines and diarrhea. Too much brooder heat, chilling, stampeding, and sudden changes in the weather occasionally are responsible for loose bowel movements.

Birds suffering from enteritis show a marked loss of appetite and appear droopy. Diarrhea is the characteristic symptom. Post-mortem examination may reveal an inflammation of the intestinal tract ranging from a mild catarrh (*mucus and pus*) to a severe hemorrhagic condition in which the intestinal walls are inflamed and spotted with blood.

The primary cause of enteritis must be determined and eliminated before effective treatment may be started. If diarrhea is only one of several symptoms observed, the birds should be examined for the presence of an infectious or parasitic disease. A list of the ailments that may produce diarrhea is found in the Diagnostic Chart on Page 153.

EPIDEMIC TREMORS

Avian Encephalomyelitis, Trembling Chick Disease

An infectious disease that strikes at the central nervous system of young chicks. Muscular tremors and lack of coordination are characteristic. The disease usually affects the chicks five days to four or five weeks after hatching. *There are no respiratory symptoms associated with outbreaks of epidemic tremors.*

Cause: A filtrable virus. Epidemic tremors is primarily an egg-borne disease. Chicks hatched from infected eggs are stricken, but there is little or no spreading of the disease to healthy members of the brood. However, recovered birds remain as carriers of the disease.

Symptoms: The initial symptoms usually are noted when the chicks are five to ten days old. The onset of the disease may pass unobserved, particularly if a small percentage of the flocks is affected. Occasionally, as much as 50 per cent of the brood may be affected. The chicks appear sluggish and drowsy and have little interest in food or water. They let out shrill, painful cries from time to time. The trembling or muscle spasms of the head, neck, and body come on suddenly; and if an ailing chick is picked up and held in the hand, the muscle vibrations may be detected easily. The chicks stagger and have a stiff, paralytic walk. Death from starvation or trampling occurs soon after the symptoms are noticed.

Diagnosis: Post-mortem examinations are negative for gross lesions. Diagnosis should be made by a poultry pathologist to eliminate the possibility of bacterial or other virus infections. Take to the laboratory only those birds showing active symptoms. When a positive laboratory diagnosis of epidemic tremors is made, many reputable hatcheries allow credit for the birds that have been lost because of the disease.

Treatment: Affected broods should not be used as laying-flock replacements. All birds showing symptoms of the disease should be destroyed. Those in the brood that are showing no nervous symptoms may be finished off as broilers. They should be raised away from the other chicks and should be the last to be cared for each day. Under no circumstances should recovered birds be used as breeders, since they are capable of transmitting the infection to their chicks.

ERYSIPELAS

An acute, infectious disease of turkeys, which may also affect chickens, ducks, pigeons, and other members of the bird family.

Cause: A bacteria, *Erysipelothrix rhusiopathiae.* This organism also causes erysipelas infections in swine and sheep, and may produce a painful skin infection in man known as *erysipeloid.* Erysipelas may be passed to poultry flocks from infected sheep or swine, and it may be carried in water that has passed through contaminated pasture land. The organism has also been isolated from fish meal used in preparing poultry rations.

Symptoms: Erysipelas is characterized by its sudden onset. It usually attacks turkeys that are four to seven months of age. The disease is most common during the late summer and fall months. It is believed that the infective bacteria gain entry to the body through injuries and other breaks in the skin. The tendency of toms to fight may be responsible for the higher incidence of the disease in males.

Sick birds usually remain apart from healthy members of the flock. They appear listless and lose interest in food. A yellow-green diarrhea may be observed. The birds may hold their heads in a crouched position with tails and wings drooping. There may be a thick mucous secretion from the nasal passages. *The caruncles and snood are swollen and have a purple tinge.* Deaths from erysipelas may be sudden, with few or no symptoms being shown. And though mortalities are usually low, they may run as high as 25 to 40 per cent of the affected flock.

Diagnosis: Erysipelas symptoms and post-mortem findings may be confused with those of fowl cholera. Suspected birds should be brought to a poultry diagnostic laboratory for a complete post-mortem and bacteriological examination. Characteristic lesions are the hemorrhagic areas scattered throughout the breast and thigh muscles and the inner tissues of the body. The pin-point hemorrhagic spots cover the membrane over the heart

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(*pericardium*). The lungs and kidneys usually are congested with blood. The spleen and liver may be several times their normal size and crumble easily when handled. The nasal passages contain a thick, sticky mucus. The intestines are inflamed and filled with a mucous discharge that may be mixed with blood.

Treatment: If the disease is caught early, some relief may be obtained from injections of penicillin (25,000 units for two to four days or a single dose of 100,000 units in oil). The antibiotic is injected into the muscles, caruncles, or wattles of affected birds. Exact dosage is determined by allowing 4,000 units of penicillin for each pound of body weight. Streptomycin has also proved effective in treating erysipelas.

Move sick or suspected flocks to new range or fresh quarters that have been disinfected with lye or phenol solutions or sprayed with steam. Keep turkeys completely separated from swine or sheep on or near the farm. They are capable of harboring and transmitting the infection. If you handle birds that have erysipelas, wear rubber gloves and otherwise protect yourself against infection. Localized and persistent wound infections of the hands should be brought to the immediate attention of your physician!

Prevention: Any and all contact between turkeys and swine and sheep should be avoided. This is of particular importance where erysipelas infections have been diagnosed in these animals. Streams that run through sheep or swine pastures should not be used as a source of water for turkeys.

Turkey toms, as well as hens, should be debeaked at three to four weeks of age. The snoods of the toms may be amputated at this time; an electric debeaking machine may be used.

Vaccination: An erysipelas vaccine is now available for the inoculation of turkey flocks. The vaccine, or bacterin, consists of erysipelas organisms whose disease-producing powers have been destroyed by formalin. The vaccine is administered when the poults are eight to twelve weeks of age. Under most conditions, it will confer a satisfactory immunity for two to three months. Directions of the manufacturer should be followed, and vaccination should be carried out by or under the supervision of your veterinarian. Hens or toms held over as breeders should be revaccinated. This may be done when the birds are being tested for pullorum.

FAVUS

White Comb

A contagious, chronic skin infection of birds and other animals, including man. The disease is caused by a fungus, *Achorion gallinae*. Favus is transmitted by direct contact with infected fowl. The fungi are present in the scales and sores of diseased birds. Flocks that are kept in damp, unsanitary quarters are most often affected.

Symptoms: Small, whi[illegible] wdery spots usually appear first on the comb,

ear lobes, or wattles. The surface of these sores flakes off giving the skin the appearance of having been sprinkled with flour. Severe cases may involve the feathered portions of the body and the feathers may fall out in patches. In the late stages, the skin becomes thickened, wrinkled, and crusty. A moldy odor may be noticed.

Treatment: Remove and destroy all infected birds. Thoroughly clean and disinfect their quarters. If treatment is desired, and only the unfeathered portions of the head are involved, the areas may be painted with tincture of iodine. Other drugs that may be used include a 1 to 1,000 dilution of bichloride of mercury or a mixture of 6 parts glycerine to 1 part iodine. If the infection has spread to the feathered parts of the body, treatment is useless. The birds should be killed and the carcasses burned or deeply buried.

GOUT

Uremic Poisoning

A condition of mature, domestic fowl that is brought on by an upset of normal kidney function. An abnormal quantity of uric acid is found in the blood stream, and chalk-like urates are deposited on the internal organs and in the joints.

Cause: The exact cause of gout in poultry is unknown. Some claim a vitamin A deficiency is responsible. Others maintain that gout is caused by kidney damage brought on by chemical or other types of poisoning. A high protein diet may make the birds more susceptible to this disorder, particularly those birds confined to battery or laying cages.

Symptoms: The symptoms of gout vary according to the extent and location of the urate deposits. When the joints are involved, they are swollen and painful and the bird shows signs of lameness. Gout usually brings on diarrhea, progressive weakness, emaciation, and eventual death.

Diagnosis: Post-mortem examination may reveal the typical chalky deposits on the coverings of the intestine, heart, and liver. The kidneys and ureters (*the tubes leading from the kidneys to the cloaca*) may be swollen and pale. The ureters are ordinarily difficult to locate, but in a bird with gout, they are plainly outlined and filled with urates.

Treatment: There is no treatment for visceral or arthritic gout. Suspected cases should be prepared for early marketing. (*See also Blue Comb Disease, Page 165.*)

HEAT STROKE

Each summer hundreds of birds die from overexposure to heat, and high humidity. In addition to the deaths from prostration, poultry affected by the heat consume less food, lose weight, and produce fewer eggs. A greater percentage of the eggs laid will be small and have poor shell quality.

Symptoms: Birds get rid of body heat by panting. Water vapor is carried off in their breath. Panting cannot always handle excess body heat because of very high temperatures, high humidity, or poor ventilation. The symptoms of overheating then become apparent. Research workers at the University of California and other agricultural experiment stations have observed the following:

Some panting occurs when the temperature reaches 80 degrees F. It becomes marked as the temperature approaches the 90 degrees mark. Water consumption increases, droppings may be loose, and feed consumption and egg production is lower.

When the temperature rises above 90 degrees F., a severe drop in feed consumption, loss of weight, and reduced egg production is noted. If water supplies are low, some heat stroke losses may result, especially among layers. Rapid breathing, panting, and holding the wings away from the body may be the first signs of impending heat prostration.

If air temperatures rise above 100 degrees F., emergency cooling measures must be taken. (*See Treatment and Prevention, following.*) Feed consumption levels must be maintained through the use of wet mash and pellet feedings. A plentiful supply of cool drinking water (*below 65 degrees F.*) must be available at all times.

Treatment and Prevention: It is far easier to anticipate and prevent heat stroke than it is to treat the condition. An emergency treatment for individual birds consists of dipping them into a bucket of cold water. If the symptoms are advanced, death will occur despite treatment.

Hot, humid summer days will exact their toll in lives and profits unless these precautions are taken:

1. Provide plenty of cool drinking water. Birds deprived of water for two or three hours may succumb rapidly. Check and recheck water supplies during a heat wave. If possible reduce the water temperature by placing ice in extra water troughs.

2. Feed liberal quantities of wet mash and pellets three or four times a day. Mix the mash so that the finished product is more watery than crumbly. Additional feeding time may be provided by turning lights on for one or two hours before dawn.

3. Provide adequate shade for growing pullets on range. Lean-to's covered with burlap sacks or branches, a growth of tall shade plants, or aluminum-roofed shelters will give protection from the direct rays of the sun.

4. Install and use roof sprinklers or fogging systems in those areas where continued periods of high temperatures are common. Foggers are of decided value where low humidity and high temperature combinations occur. A thermostatic control may be installed to automatically turn on sprinklers or foggers when the temperature goes above 90 degrees F. In emergencies, a garden hose may be turned on the roof until the temperature in the pens

has dropped from 5 to 10 degrees. The chore is a laborious one, but it will help reduce losses.

5. Consider redesigning old buildings or constructing new houses to provide built-in protection against extremes in the weather. Insulated side walls and ceilings, aluminum roofs or roofs painted with light colors, and mechanical systems of ventilation are advantageous. Other aids to hot weather comfort include an adequate allowance for floor space and feeding and watering facilities and at least one nest for every five hens. Prompt detection and control of lice and mites is particularly important during the summer months.

HEMORRHAGIC DISEASE

Hemorrhagic Syndrome

An obscure condition affecting domestic fowl from three to 12 weeks of age. The disease is characterized by bleeding into the internal tissues and deep muscles of the body.

Cause: A number of theories have been advanced as to the cause of hemorrhagic disease. These include a vitamin K deficiency, indiscriminate use of sulfa drugs and antibiotics, and a specific virus.

Vitamin K is essential to the normal clotting of blood. Should the body be depleted of this vitamin because of an inadequate diet, uncontrollable hemorrhaging may result. It is believed that overdosing with certain drugs interferes with or destroys the vitamin K in the feed or kills off the harmless bacteria that synthesize the vitamin in the intestinal tract. All medication should be given as recommended by the manufacturer. Do not combine two or more drugs unless indicated by the manufacturer or recommended by your veterinarian.

A virus or viruses, acting alone or in conjunction with the aforementioned factors, may cause or predispose flocks to hemorrhagic disease. However, no evidence is available to prove that the disease is of a contagious nature.

Symptoms: Affected birds are quite often the fattest, healthiest looking members of the flock. Most outbreaks are seen in birds four to seven weeks old. Pale combs, ruffled feathers, bloody droppings, and general signs of weakness may be noted. But no visible symptoms may be observed other than the typical hemorrhagic areas discovered on autopsy. These patches of blood may be found deep in the muscles of the leg, breast, and heart. Blood found in the intestinal tract may cause the lesions to be confused with those of coccidiosis. Bleeding may occur in the gizzard, proventriculus, and pancreas. The kidneys may be hemorrhagic and filled with chalky deposits that resemble the lesions of pullet disease. Deaths range from 1 per cent to 30 per cent or higher. A laboratory diagnosis should be obtained in suspected outbreaks.

Treatment: Increase the amount of vitamin K by feeding an additional 5 per cent alfalfa meal or alfalfa leaf meal. Vitamin K in the form of a synthetic preparation (*menadione*) may be added to the water or feed. Take all necessary precautions when handling the flock during caponization, vaccination, or deworming. Do not disturb the flock unnecessarily. Use extreme caution when administering sulfa drugs or antibiotics. Do not use high-level treatment with drugs until an accurate laboratory diagnosis has been obtained.

INFLAMMATION OF THE OVIDUCT

Salpingitis

An inflammatory condition of the lower portion of the oviduct or egg duct characterized by loose, watery droppings mixed with a white, creamy discharge. The feathers around the vent are apt to be soiled, and the skin may be red and inflamed. The affected hen becomes a natural target for cannibalistic birds. Hens suffering from salpingitis are usually dull and listless. If still in production they tend to lay bloody, rotten, yolkless, soft-shelled, blood-smeared, or poorly shaped eggs. The birds frequently become egg-bound.

For all practical purposes, inflammation of the oviduct is considered incurable. It is advisable to cull and slaughter such cases immediately.

KERATO-CONJUNCTIVITIS

A non-infectious disease of young, growing birds characterized by severe inflammation of the tissues of the eye. Involvement of the cornea (the transparent covering of the eye) or the iris or lens results in blindness.

Cause: Kerato-conjunctivitis occurs most frequently during the winter months. It is caused by an accumulation of ammonia fumes produced by the faulty handling of compost litters. The condition is aggravated by poor ventilation and overcrowded quarters. Ammonia fumes are heavier than air and settle near the floors of poultry houses. Unless these fumes are carried off by means of natural or mechanical ventilation, they will irritate the sensitive tissues of the eye.

Symptoms: In some outbreaks as much as 50 per cent of the flock may show inflammation of the eyeball, tearing, and blindness. Small sores or ulcers may develop on the affected surface of the eye. The severe pain that accompanies the infection causes the birds to keep their eyes closed and to remain in one spot. Because of loss of weight, there will be a high percentage of low-grade birds and culls when the pen is marketed.

Treatment: Like most poultry diseases, kerato-conjunctivitis is easier to prevent than treat. If individual treatment is desired, the inflamed tissues may be rinsed with a warm boric acid solution, and a soothing ointment such

as yellow oxide of mercury placed in the eye. Ventilation of the birds' quarters must be improved and the droppings removed from the house.

Prevention: Do not crowd young, growing chicks, especially during the winter months. If compost litter is used (not recommended by the author for young birds) be sure that optimum ventilation is made possible. Keep the litter dry through daily stirring or raking. Use superphosphate or a similar material in the litter and on the dropping boards or pits to help reduce odors and to keep the litter dry.

LARYNGOTRACHEITIS

Chicken Influenza, Infectious Tracheitis

A highly contagious and rapidly fatal respiratory disease of chickens and pheasants. Other species of fowl apparently are immune. Laryngotracheitis usually is encountered during the fall and winter. It primarily affects adult birds five to ten months old. It has recently been reported to exist in concentrated broiler areas. However, the disease is ordinarily not seen in chicks of less than ten weeks of age.

Cause: A filtrable virus. Birds that have recovered from a *natural* attack of the disease may continue to spread the virus to susceptible flocks. Birds that have been vaccinated successfully do *not* remain as carriers of the infection. The disease may be carried from farm to farm on contaminated crates, shoes, clothing, used feed bags, and other articles.

Symptoms: Laryngotracheitis appears suddenly and spreads rapidly through the flock. The principal symptom is difficulty in breathing, evidenced by wheezing, rattling, *gasping,* and coughing. Often the breathing is so labored the bird must raise its head, extend its neck, and inhale through the open mouth. The bird will then draw the neck in, depressing its head on its breast to exhale. The characteristic motion is repeated with each breath. (*See Plates 44a and 44b.*)

Coughing is a common symptom. The bird shakes its head trying to expel the bloody mucus from its mouth and nose. Normally the disease is of short duration; most of the birds either recover or succumb to the infection within one week. There is a marked loss of egg production, and normal egg laying may not be restored for two or three months. The number of dead birds may range from a low of 5 per cent to a high of 60 per cent of the affected flock. Death is brought on by suffocation caused by obstruction of the larynx with bloody mucus or a thick cheese-like plug. Symptoms in young birds are usually mild and may be mistaken for those of infectious bronchitis.

Diagnosis: Internal lesions are confined to the larynx (*voice box*) and trachea (*windpipe*), which contain a variable amount of mucus mixed with pus or blood. The mucous lining of the respiratory tract is severely inflamed and covered with a substance that becomes thick, yellow, and, eventually, hardened and cheese-like. This condition is responsible for the difficult

breathing and suffocation. The respiratory symptoms of laryngotracheitis may be confused with those of infectious bronchitis, Newcastle disease, or coryza. The Diagnostic Chart on Page 197 points out a few differences between the various respiratory infections. An accurate diagnosis is possible only with laboratory methods.

Treatment: There is no effective treatment for laryngotracheitis. Drugs, whether placed in the feed or water or sprayed over the birds, have little or no effect on the progress of the disease. Prompt vaccination of unexposed birds and those not yet showing symptoms should prevent the infection from spreading. Antibiotic feeds may stimulate appetites and help maintain normal weight gains in recovered or vaccinated flocks.

Prevention: This disease can best be prevented with thorough and consistent sanitation and *proper vaccination*. Birds may be vaccinated any time after they are six weeks old. In concentrated broiler areas where laryngotracheitis has been encountered, vaccination may be carried out when the broods are three to four weeks of age. Broiler flock vaccination should be carried out only on the advice of your veterinarian or state poultry pathologist. Birds that have been successfully vaccinated will not spread the virus after one week from the time of vaccination. Birds that have recovered from natural attacks are immune, but they carry the disease and are a potential source of infection for other birds. The viruses from these apparently healthy birds are present in their nasal discharges and contaminate anything with which they come in contact. Shipping crates, waterers, feeders, and other equipment used by carrier birds should be disinfected before being used again. The virus may be destroyed by steam or solutions made of saponified cresol, sodium orthophenylphenate, or lye (one can of lye to 5 and one-half gallons of water). Birds recovered from a natural infection should be disposed of at the end of their laying year. Houses and equipment used by these birds should receive a thorough cleaning and disinfecting.

A discussion of vaccination recommendations is on Page 220.

BIRD MALARIA

Leucocytozoon Disease

A malaria-like disease affecting turkeys and ducks and brought on by an invasion of the blood stream by the protozoan parasites, *Leucocytozoon smithi* and *anatis*. The disease is transmitted to susceptible birds by the bites of the black horse flies (*simulids*), which act as intermediate hosts for the blood parasites.

Symptoms: In young ducks and poults, the disease may be manifested by loss of appetite, droopiness, weakness, coma, and death. Affected birds have a tendency to lie down most of the time. They consume great quantities of water. The symptoms displayed are due to the parasitic destruction of red blood cells. Recovered birds should not be saved for breeding, since they

may remain as carriers of infection although no longer showing active symptoms.

Diagnosis: An accurate diagnosis for the presence of the parasites can be made only by examining blood smears taken from suspected birds. Findings on post-mortem may include an intense yellow discoloration of body tissues, an enlarged, scarred liver, and a dark, swollen spleen.

Treatment: There is no practical treatment for bird malaria. Affected birds should be marketed as soon as possible. However, reports have shown that sulfaquinoxaline, given in the drinking water at dilutions of 1:2,500 for two days and then for three or four days at dilutions of 1:4,000 may reduce losses. Recovered birds should be disposed of before new animals are added to the flock. Control of black flies is essential if the spread of the disease is to be stopped.

Prevention: Complete segregation of brooding and rearing operations is a prerequisite to the prevention of malaria outbreaks. Because the disease is spread by the bites of the black fly, screening to protect the birds from the flies will help considerably. It is advisable to brood during those times of the year when the black fly population is at its lowest. Confinement rearing of young stock and periodic laboratory examination of suspicious birds should be made a part of the disease control program.

NAVEL INFECTION

Omphalitis, "Mushy Chick Disease"

A disease of newborn chicks and poults characterized by infection of the navel and yolk sac. This condition is associated with faulty incubation and unsanitary hatching environment.

Cause: Failure of the navel to close properly soon after hatching allows bacteria to enter the body. Lack of sanitation, excessive humidity during incubation, and other poor management practices increase the incidence of the disease.

Symptoms: Chicks with navel infection appear weaker and more depressed than other members of the brood. Poor appetites, shivering and huddling, and a swollen, inflamed navel are other indications of infection. Symptoms may start soon after hatching and reach their peak when the chicks are two or three days old. Mortality may be as great as 50 per cent of the brood, with many chicks succumbing at the hatchery or during shipment to the farm.

Diagnosis: Chicks that have died from navel infection are soft and mushy and give off an offensive odor. The skin over the abdomen appears waterlogged and flabby and the inflamed navel may be covered with a scab. When the body cavity is opened, unabsorbed remnants of the yolk sac are noted. A thick, yellow exudate may cover the intestines and other abdominal

breathing and suffocation. The respiratory symptoms of laryngotracheitis may be confused with those of infectious bronchitis, Newcastle disease, or coryza. The Diagnostic Chart on Page 197 points out a few differences between the various respiratory infections. An accurate diagnosis is possible only with laboratory methods.

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Diagnosis: An accurate diagnosis for the presence of the parasites can be made only by examining blood smears taken from suspected birds. Findings on post-mortem may include an intense yellow discoloration of body tissues, an enlarged, scarred liver, and a dark, swollen spleen.

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organs. The unabsorbed yolk is of a semi-solid consistency and is the main source of the putrid odor.

Paratyphoid and pullorum disease produce symptoms and lesions that may resemble those of navel infection. Laboratory tests will eliminate the possibility of confusion with these diseases.

Treatment: Careful nursing of the sick birds and increasing brooder temperatures may reduce the number of deaths. The use of sulfamethazine, sodium sulfathiazole, or antibiotics in the drinking water may help check the infection. Navel infection can be prevented if care is taken with incubator sanitation and management. (*See Plate 45.*) Poultry authorities recommend a double or triple-strength fumigation with formaldehyde and potassium permanganate between hatches, particularly if incubator diseases have existed on the premises. (*See also Pullorum Disease, Page 209.*)

NECROTIC ULCERATION OF THE CROP

Trichomoniasis of the Upper Digestive Tract

A condition of the crop, esophagus, and stomach (*proventriculus*) affecting young chickens, turkeys, and pigeons. The disease, which is associated with poor management and a lack of sanitation, is caused by a protozoan parasite, *Trichomonas gallinae* that attacks the upper portions of the digestive tract. The protozoa are often found in stagnant water, spoiled feed, and moldy litter. Pigeons and quail may introduce the disease to susceptible flocks by contaminating feed, soil, or water with infective droppings or discharges from the mouth.

Symptoms: Birds that are parasitized with the trichomonad organisms are droopy and suffer a loss of appetite. They will be seen extending their necks and making frequent attempts to swallow. A foul-smelling liquid drools from the bird's mouth. The head is dark in color and the tissues over the sinuses may be sunken. A depression of the chest also is evident. The crop, which is empty of all food, is drawn toward the body. Young birds often die within one or two days after the first symptoms are noticed. Older birds may linger for a few weeks before death overtakes them. Emaciation and general weakness usually precede death. As many as 50 per cent of the sick birds may die.

Diagnosis: Trichomoniasis is diagnosed on the basis of the symptoms observed and on the identification of the causative organism from scrapings taken from fresh lesions on the crop, proventriculus, or esophagus. These tissues may be covered with a cheesy substance having a foul odor. There may be evidence of small, white nodules or open sores and the entire mucous membrane of the crop or esophagus may be destroyed in severe cases.

Treatment: The first step is to eliminate the source of infection, which may be polluted water, spoiled or contaminated feed, or moldy straw. Treatment then consists of adding 1 level teaspoonful of powdered copper sulfate

to every 5 gallons of drinking water. Dissolve the correct amount of copper sulfate in boiling water first, then mix the solution with the rest of the water. Place the medicated water in front of the birds in non-metallic containers for three days. Then substitute untreated water for two days. After this time, use the copper sulfate solution for another three days, or until the symptoms have been alleviated. The sick birds should be prepared for early market and the premises should be cleaned thoroughly and disinfected before new birds are added. Recommendations for the prevention of blackhead apply to this disease. (*See Page 164.*)

NEWCASTLE DISEASE

Pneumoencephalitis

An acute, highly contagious respiratory and nervous ailment affecting both young and old chickens. Turkeys and other members of the avian family are also susceptible. The disease strikes suddenly and spreads rapidly throughout the broods or laying flocks.

Cause: A filtrable virus. Newcastle disease may spread from actively infected flocks to susceptible birds through discharges from the respiratory and digestive tracts. The birds may acquire the infection by inhaling the virus or by ingesting contaminated feed or water. Newcastle may be carried from one farm to another by wild birds, poultry buyers, salesmen, or visitors that have been in contact with diseased flocks. Contaminated egg crates and used feed bags or equipment used by cullers, blood testers, or vaccinating teams may help spread the disease. Chicks that hatch from infected eggs and chicks exposed in transit may acquire the infection.

Symptoms in Chicks: The first symptoms noticed are gasping, coughing, and rattling. In the beginning Newcastle disease symptoms are indistinguishable from those of chick bronchitis or laryngotracheitis. Two or three days after the respiratory symptoms have appeared, there are signs of disturbances of the nervous system. The chicks lack coordination and suffer from nervous trembling and paralysis. Ailing chicks stand with their heads either drawn back, sunken between the shoulders, dropped down toward the breast, or twisted to either side. The abnormal postures have been described as "stargazing," "downbending," "twisting," and "turning." The chicks walk backwards, lie on their sides, turn somersaults, make aimless circles, and fall down helplessly. Finally, spasms, with the muscles twitching repeatedly, are followed by coma and usually death. As high as 90 per cent of the stricken brood may die. (*See Plate 46.*)

Symptoms in Adult Fowl: Gasping, coughing, and rattling may be the first symptoms noticed. In some outbreaks the respiratory symptoms are mild and may pass unobserved. *Laying birds suffer a complete and sudden cessation of egg production.* Egg production of heavily producing flocks will drop to zero in a matter of five or ten days. A large percentage of eggs

that *are* laid will be laid on the floor and many will be soft shelled or misshapen. Lowered feed consumption is an additional symptom. The coughing and sneezing stage passes rapidly and within a week or ten days almost all respiratory symptoms disappear. Appetites gradually improve and egg production begins an upward climb, becoming normal within 30 or 40 days. A few flocks may even exceed the original rate of egg production. The interior quality of the eggs improves rapidly in marked contrast to the poor eggs laid by flocks that have recovered from bronchitis.

A variable number of adults will show the nervous symptoms described for chicks. Birds that develop the nervous form of Newcastle disease may never recover normal use of the affected limbs. The mortality rate among growing birds ranges from 10 to 20 per cent while only 5 per cent or less of the adult birds will die. If the chronic respiratory disease organism is present, complications may result, interfering with complete recovery. Broiler and fryer flocks are especially hard hit when Newcastle disease and chronic respiratory disease strike. Excessive losses in weight are suffered and a high percentage of culls and low-grade birds are found when the flocks are marketed.

Diagnosis: Bronchitis, coryza, laryngotracheitis, and chronic respiratory disease produce symptoms similar to those of Newcastle disease. An accurate differential diagnosis of all respiratory infections is best made at a poultry laboratory. Whenever possible, submit birds to the laboratory in person. If the owner or caretaker is on hand with accurate information regarding history and management of the flock, the pathologist will be better able to suggest a control and preventive program. Submit birds that are showing typical respiratory symptoms, as well as some that may be demonstrating nervous symptoms. Be sure that a representative sampling is taken. One or two isolated birds, or birds that are dead before they arrive at the laboratory, may prove valueless to the technician conducting Newcastle and other diagnostic tests.

The following chart is included as a guide for the poultryman in making a tentative diagnosis on the basis of clinical symptoms. (*See also Fowl Pox, Page 207 and Fowl Cholera, Page 172.*)

Treatment: There is no cure for Newcastle disease, nor is there any effective method of checking the spread of the disease once it has started. Good care, which must include ample warmth and freedom from drafts, may shorten recovery time. Appetites can be stimulated with frequent feedings of hot wet mashes, pellets, tender fresh greens, or feeds containing antibiotics, such as terramycin, aureomycin, or penicillin.

On the advice of your veterinarian or poultry pathologist, the vaccination of exposed, susceptible birds may be carried out with either a mild, live vaccine or a dead virus vaccine. (*See Page 222.*)

Prevention: Guard against re-introduction of the virus from neighboring

flocks and other outside sources. The following measures will help keep the flock free of Newcastle and other diseases. Sell layers, other than those retained for breeding, at the end of their first laying year (*18 months*). Maintain an all-pullet flock. It will pay dividends with increased and more profitable egg production, as well as with fewer losses from various poultry ailments. Whenever possible, raise only one batch of broilers at a time. If *more than one age group must be raised, use separate buildings for the*

CHART 17

	Newcastle	*Bronchitis*	*Laryn-gotracheitis*	*Chronic Respiratory Disease*
Drop in egg production	May drop to zero	10 to 75%	5 to 15%	Variable, 2 to 20%
Nervous symptoms	Chicks, 40% Adults, 2%	None	None	None
Sudden onset, rapid spread	Yes	Yes	Yes	No
Duration	2 weeks	2 weeks	2 to 3 weeks	2 to 4 months
Mortality in chicks	25 to 90%	5 to 40% or more	Disease rare in chicks	5 to 10%
Mortality in adults	2 to 5%	None	Up to 50%	Little or no mortality, many culls

different broods. Keep replacement birds and breeders apart from laying flocks. *Thoroughly clean and disinfect houses and equipment before adding new chicks.* The Newcastle virus is destroyed by most poultry disinfectants. Buy only day-old chicks or poults. Bring no adult birds onto the farm. Do not buy feed contained in used sacks. Do not use equipment that has been in contact with poultry unless it has been disinfected thoroughly. Do not allow in the poultry yards or houses visitors who may have been in contact with other birds. Buy chicks from reliable hatcheries only and raise them apart from older birds. Chicks that are reared in clean, warm quarters, free of drafts and excessive moisture, and that receive adequate amounts of nourishing feeds, are in a better position to ward off diseases. Proper management is 90 per cent of the problem of rearing healthy and profitable birds.

A discussion of vaccines and vaccination methods used in protecting chickens and turkeys against Newcastle disease is on Page 222.

NUTRITIONAL DISEASES

Vitamins and minerals are essential to the good health, growth, and reproduction of poultry flocks. These nutrients are often the key to successful

incubation, hatching, and rearing of profitable broods. The following chart outlines the important ailments caused by nutritional deficiencies, their effects, and requirements for prevention. Most of these conditions are rare when well-balanced, freshly milled feeds are used. Deficiencies in the diet may be offset by the addition of vitamin and mineral supplements. If you are mixing your own feeds, consult your local farm advisor or the poultry nutrition specialist at the state college about feed formulas and nutritional requirements.

CHART 18

Vitamin Deficiency	*Symptoms of Deficiency*	*Autopsy*	*Requirement Per Pound of Feed*
Vitamin A	Nutritional roup; eyes swollen, watery; nasal discharge. Egg production and hatchability reduced. Birds susceptible to colds. More deaths	Yellow-white pustules in mouth and esophagus. Cheesy substance in nostrils. Chalky deposits in cloaca, vent, heart, kidneys	Chicks, 2,000 I.U. Breeders, 3,300 I.U. Turkeys, 4,000 I.U.
Vitamin D (*Also calcium and phosphorus*)	Rickets; stunted growth; weakness; stiff walk; lowered hatchability; soft-shelled eggs; crooked breast bones, legs	Beading of ribs; soft bones; thick leg bones; crooked keel bone; spinal curvature	Chicks, 135 I.C.U. Breeders, 340 I.C.U. Turkeys, 600 I.C.U.
Vitamin G (*Riboflavin*)	Sore mouth, scab on mouth; diarrhea; impaired growth; drop in egg production; "curly toe" paralysis; decreased hatchability	No internal lesions	Chicks, 1.6 mg. Breeders, 1.3 mg. Poults, 2.0 mg. Turkeys, 1.6 mg.
Vitamin B_1 (*Thiamine*)	Deficiency rare. Loss of appetite; polyneuritis; emaciation; nervousness; convulsions	No visible internal lesions	Chicks, 0.9 mg. No exact requirements for older birds
Vitamin B_6 (*Pyridoxine*)	Deficiency rare. Retarded growth; convulsions; decreased egg production and hatchability	No internal lesions	Chicks and poults, 1.0 to 1.6 mg.
Vitamin E (*Alpha tocopherol*)	Needed for chick embryo growth. Lowered fertility in cockerels. Crazy chick disease, 2 to 4 weeks of age; lowered hatchability	No visible internal lesions	No exact requirements
Vitamin H (*Biotin*)	Dermatosis. Impaired hatchability; perosis; inflammation of skin and mouth	Slipped tendon; enlarged hocks; deformed hock joint; bending of bones	Chicks, 0.045 mg. Layers and breeders, 0.07 mg. No exact turkey requirements

Vitamin K	Blood fails to clot; fatal hemorrhaging (*See Page 189*)	Unclotted blood; pinpoint hemorrhages	Chicks, 0.18 mg. No exact adult requirements
Niacin (*Nicotinic Acid*)	Poor feather and body growth. Eczema of skin and feet. Inflammation of mouth, esophagus, crop	No visible lesions	Chicks, 8.0 mg. No other exact requirements
Pantothenic Acid (Anti-dermatitis factor)	Essential for normal growth and development. Scabs at corners of mouth and eyelids; emaciation; reduced hatchability	Enlarged liver, thick exudate in proventriculus. Microscopic changes in nerves	Chicks, 5.0 mg. Layers, 2.5 mg. Breeders, 5.0 mg. Turkeys, 6.0 mg.
Choline	Slipped tendon disease, (*perosis*) bone displacement; poor egg production; poor growth	Slipped tendon	Chicks, 700 mg. Poults, 900 mg.
Inositol	Impaired growth	No lesions	No exact requirements. Deficiencies rare in feeds
Folic Acid (*Vitamin B, Vitamin M, Factor U, Factor R*)	Poor hatchability. Lowered egg production; impaired growth; slipped tendon disease; stiff neck paralysis in turkeys	Slipped tendon	Chicks, 1.3 to 3.5 mg.
Vitamin B_{12} (*Cobalmin*)	Impaired growth and feathering. Poor hatchability	No lesions	Chicks and adults, 2 micrograms
Vitamin B_{13}	Impaired growth	No lesions	No exact requirements
Manganese	Slipped tendon disease	Evidence of slipped tendon	4 to 8 ounces manganese sulfate per ton of feed

POULTRY PARASITE CONTROL

Most parasitic infestations can be controlled and prevented through proper management and sanitation. The following points are important to the raising of parasite-free birds:

1. Raise chicks and growing stock away from adult birds. An adult hen is a potential source of infection for young birds. Coccidiosis, roundworms, and certain virus and bacterial infections may be transmitted from adult carriers to susceptible chicks and poults. (*See Plate 47.*)

2. Do not use range or pasture that is in a direct line of drainage from high land. Low-land ranges are less desirable than those located on high, dry ground. The wet spots are natural incubators for bacteria and parasites.

CHART 19

Vitamin	*Source of Vitamin*
Vitamin A	Fish liver oils, yellow corn, carrots, corn gluten meal, alfalfa meal, green grass
Vitamin D	Fish liver oils, sunlight, sun-cured hay
Vitamin G	Green feeds, alfalfa meal, milk products, whey, meat scraps, fish meal, Brewer's yeast, liver, fermentation residues
Vitamin B_1	Whole grains, wheat by-products, soybean, peanut, linseed, and cottonseed oil meals, Brewer's yeast, skim milk, buttermilk, alfalfa, green feed
Vitamin B_6	Same as Vitamin B_1 and cane molasses and liver meal
Vitamin E	Grains, wheat by-products, wheat germ oil, alfalfa meal, green grasses, corn oil, soybean oil, cottonseed oil
Vitamin H	Grains, wheat by-products, rice by-products, Brewer's yeast, alfalfa meal, green grasses, cane molasses, liver, soybean meal
Vitamin K	Alfalfa meal, cereal grasses, green grasses, fish meal, meat scraps, liver meal
Niacin	Bran middlings, peanut meal, whole wheat, meat products, soybean oil meal, dried Brewer's yeast, wheat and rice by-products, corn gluten meal, liver
Choline	Wheat, oats, wheat by-products, soybean and peanut meal, yeast, meat scraps, liver, fish meal, milk products, cottonseed meal
Inositol	Grains, wheat products, alfalfa meal, peanut meal, cereal grasses, milk products, yeast products, liver
Folic Acid	Alfalfa, yeast, milk, wheat, grass, soybean and rice products, peanut meal, cereal grass, liver
Pantothenic Acid	Grass, liver, wheat, oats, wheat by-products, dried milk and whey, Brewer's yeast, alfalfa meal, fish solubles, corn gluten meal
Vitamin B_{12}	Alfalfa meal, liver and fish meal, fish solubles, meat scraps, milk products
Vitamin B_{13}	Soybean meal, fish meals, distillers' by-products, milk by-products

3. Reduce fly and insect population. Flies may transmit bacterial and virus infections. (*See Figure 19.*) They also serve as intermediate hosts for the poultry tapeworm. Snails, slugs, cockroaches, and beetles are also potential carriers of internal poultry parasites. Keep wild birds out of poultry houses by covering windows with a fine wire mesh.

4. Treat the lumber used in poultry houses with carbolineum or other suitable mite repellents. (*See Plate 48.*) Wooden roosts and nests should be treated in the same way. Metallic nests and feeders are preferred over those of wooden construction. The poultry red mite is attracted to dark crevices, especially wood cracks. Anticipate their visits by painting with carbolineum.

5. *The use of old, built-up litter for young stock is not recommended.* Old litter is suited for one purpose only, and that is for making compost heaps. Clean, dry litter, built up to a height of 6 to 8 inches, is preferred, particularly for growing birds.

6. Do not spread poultry manure on ranges or pastures that are to be used for chickens or turkeys. If manure must be used on such land, it should be left in compost heaps long enough to destroy parasite eggs.

7. Clean the dropping boards and pits regularly.

8. Use wire platforms to minimize fecal contamination of feeders and waterers. Use them for the young as well as the old stock.

9. Maintain clean exercise yards. Remove waste and old equipment that might harbor and protect parasites and their eggs.

10. Rotate yards and ranges on a two or preferably a three-year basis.

11. Avoid combining poultry and turkey enterprises. (*See Plate 49.*)

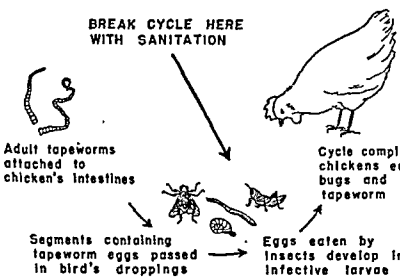

Fig. 19. Tapeworm infestations are best prevented by keeping fowl away from the insect intermediate hosts. Screened compost heaps and other fly control measures will materially reduce the tapeworm problem.

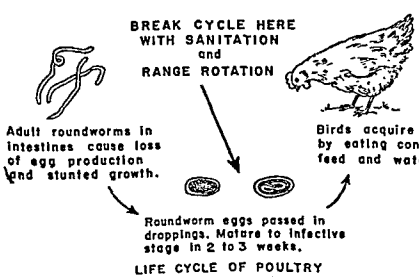

Fig. 20. Roundworm life cycle. Severe infestations with the large intestinal roundworm may seriously affect the health of growing and mature fowl. General sanitation and adherence to a range rotation program will minimize the number of infective roundworm eggs.

Segregate turkeys so they do not have access to poultry manure. Cecal worm transmission from chickens to turkeys may increase the incidence of blackhead infections.

12. Treat and worm birds for internal parasites *only after an accurate diagnosis has been made by a poultry pathologist.*

CHART 20

COMMON INTERNAL PARASITES OF POULTRY

Name and Location	*Symptoms*	*Transmission*	*Control*
Eye Worm (*Under third eyelid*)	Blindness, irritation, discharge from eye	Cockroach is intermediate host	No treatment. Avoid contact with cockroach. Remove worm from eyelid
Crop Worm (*Mucous membranes, crop*)	Inflamed crop, weakness, loss of appetite	Earthworm	No treatment
Large Roundworm (*small intestine*)	Emaciation, weakness, diarrhea, blocked gut, deaths	Direct fecal contamination	Sanitation. Carbon tetrachloride, nicotine-sulfate, colloidal iodine, phenothiazine, piperazine compounds
Gape Worm (*trachea and lungs*)	Pneumonia, suffocation, high mortality in chicks	Direct and by earthworm	Keep in houses or wire cages; raise on sandy soil; treat with barium antimonyl tartrate
Tapeworms (*small intestine*)	Loss of weight, no appetite, emaciation, diarrhea, loss of egg production	Intermediate host, slug, snail, fly, dung beetle, earthworm, housefly, and grasshopper	Sanitation. Reduce fly population; treat with "Di-Phenthane 70" or "Butynorate"
Cecal Worm (*ceca, or blind gut*)	Inflamed ceca; worm transmits blackhead to turkeys	Direct and by earthworm	*Sanitation.* Use of phenothiazine
Stomach Worm (*stomach*)	Impaired digestion, weakness, diarrhea	Grasshopper, cockroach	No treatment. Keep birds from insects
Gizzard Worm (*gizzard*)	Damage to gizzard, impaired digestion	Grasshopper, flour beetle, sandhopper	No treatment. Keep birds from insects
Capillaria or Hairworm (*upper part of intestine*)	Emaciation, diarrhea, weakness, anemia	Direct fecal contamination (old litter)	Sanitation. Use clean litter; treat with carbon tetrachloride, tetrachorethylene, or phenothiazine

Note: See also Coccidiosis, Page 176; Blackhead, Page 164; and Catarrhal enteritis, Page 172.

CHART 21

COMMON EXTERNAL PARASITES OF POULTRY

Parasite	*Damage*	*Treatment and Prevention*
Lice (*seven species; head, wing, body, and fluff lice*) (*See Fig. 23*)	Irritation; loss of weight and egg production: lowered resistance to disease	Sanitation; screen windows with fine wire mesh. Use sodium fluoride dust, 40% nicotine-sulfate roost paint, DDT spray or dust, lindane roost paint or spray, lindane, or malathion dusts in litter (*Below)
Red Mite or Roost Mite (*Hides under roosts, nests, and in dark cracks. Feeds on birds at night*) (*See Fig. 21*)	Irritation; loss of blood; birds anemic, droopy; loss of weight and egg production	Lindane and DDT sprays, neotran, malathion, nicotine-sulfate, and lindane sprays. Paint roosts with carbolineum
Gray Mite, or Northern Feather Mite (*Seen on eggs, black specks around fluff feathers*) (*See Fig. 22*)	Irritation; loss of blood; scabby appearance of skin; lowered egg production; loss of condition	Screen windows against sparrows; malathion, neotran, *or* sulphenone dusts and sprays; nicotine-sulfate *or* DDT with lindane as spray. 40% nicotine-sulfate or lindane roost paints
Depluming Mite (*seen on shaft of feather*)	Irritation. Birds pull feathers out	Sanitation; clean nests; spray with nicotine-sulfate, lindane mixture; one part flowers of sulfur mixed with four parts petrolatum applied to affected parts
Scaly Leg Mite (*Relatively rare*)	Lameness; enlarged, scaly leg. Scaly leg disease	No treatment advised. Slaughter birds
Ticks or Blue Bugs (*Attack at night*)	Suck blood; will attack humans; birds lose appetites	Sanitation; burn all litter and trash; treatment same as for red mites; repeat treatment is needed. Paint roosts with carbolineum
Chiggers, Harvest Mites, or Red Bugs (*found all over the body*)	Itching; loss of appetite; blisters and abscesses	Keep birds off infested range. Treat with flowers of sulfur dust
Sticktight, or Tropical Chicken Flea (*also attacks dogs, cats, and rats*)	Flea clusters on comb, wattles, earlobes, and around eye; loss of weight and egg production; mortality if infestation is great	Keep dogs and cats away from chicken houses and runs. Reduce rat population. Use sulfur ointment on affected head parts. Spray house with DDT or lindane

* *Note:* An effective spray recommended by Cornell University entomologists against lice and the red and northern fowl mites can be made by combining 4 per cent nicotine-sulfate *or* DDT with a one-quarter per cent lindane solution. Additional chemicals that may be used against external parasites include toxaphene, benzene-hexachloride, dieldrin, aldrin, and chlordane. Consult county extension agents for advice on applying these compounds. When using commercial preparations, be sure to follow the manufacturer's directions.

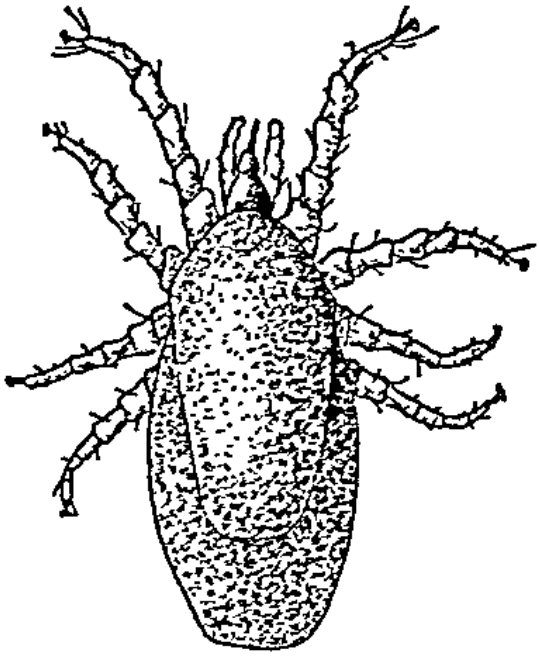

Fig. 21. Red mite, Dermanyssus gallinae. This parasite attacks fowl at night. During the day it hides in cracks and crevices of the roosts, nests, and other dark places in the chicken house.

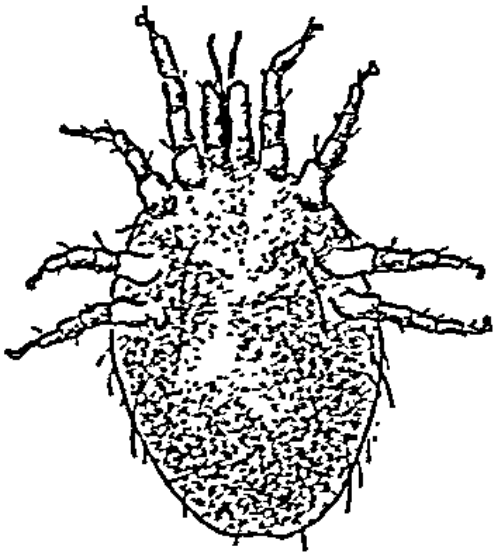

Fig. 22. Feather mite, Lipanyssus sylviarum. This mite may live on the fowl at all times. The greatest numbers will be found in the feathers below the vent, and around the tail and neck. The parasite may be spread to poultry flocks by infested English sparrows.

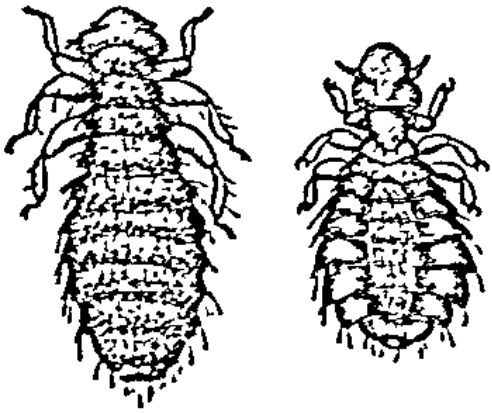

Fig. 23. The common body louse (left) and the head louse (right) of chickens. These external parasites irritate the birds and may cause loss of weight, a drop in egg production, and sometimes death. (Courtesy of the U. S. Department of Agriculture.)

PARATYPHOID INFECTION

Salmonellosis, Megrims

Paratyphoid infections affect all members of the fowl family. In recent years the problem has become of paramount importance to the turkey grower because of an increase in the number of cases of the disease. Paratyphoid is characterized by a generalized infection that strikes young birds one to three weeks after hatching. Mortality may range from 10 per cent to 90 per cent of affected broods.

Cause: Any of more than 50 salmonella bacteria may cause paratyphoid. The disease may be spread through fecal contamination of hatching eggs before or during incubation. Transmission through the eggs is possible. Food or water contaminated with the droppings of infected carrier birds may be responsible for spreading the disease. Spoiled eggs containing the paratyphoid bacteria may cause food poisoning in humans.

Symptoms: Birds may be stricken from three to seven days after hatching. Mortality is highest between the second and third weeks. The birds have little or no interest in food and appear droopy and listless. They are easily chilled and seek sources of heat constantly. Diarrhea is common. Losses may be severe if the brood is overheated, chilled, or subjected to overcrowding. Birds that do not succumb to the initial attack may remain stunted and emaciated. Pigeons suffering from paratyphoid develop abscesses around the joints of the wing. Affected squabs show extreme weakness, a nervous shaking of the head, and a wobbly walk. Birds that recover from paratyphoid may remain as carriers of the infection and under no circumstances should be used for breeding.

Diagnosis: Autopsy of the dead birds may not always reveal significant changes of the internal tissues. There may be some evidence of unabsorbed yolk, inflammation of the intestinal tract, congestion of the lungs, and swelling of the liver. Occasionally, dry, hard, cheesy plugs may be found in the cecal tubes. Positive diagnosis of paratyphoid can be made only through bacteriological examination and identification of the causative organism.

Treatment: Sulfaquinoxaline, sulfamerazine, sulfamethazine, and furazolidone, if administered in the early stages of infection, may reduce losses. These drugs do not eliminate the infection, but they will impede its progress. They should be given according to the manufacturer's directions. Mortality can be kept to a minimum by increasing brooder temperatures, providing fresh, warm water continuously, and supplying adequate amounts of nourishing food. Hot, wet mashes, pellets, and antibiotics will keep up feed consumption. Isolation of ailing birds, strict adherence to sanitation, and constant culling will help check the disease. Recovered birds should be marketed as soon as possible. They represent a constant source of infection. Depopulation may be carried out if other measures of control fail.

Prevention: Strict sanitation during incubation and brooding may help

prevent infection. Do not feed turkey or chicken eggs to young or breeding stock; keep young birds segregated from older birds; minimize rodent populations; and, whenever possible, buy chicks or poults from non-infected sources. The breeder should follow a program of incubator fumigation and disinfection during and between hatches. A double-strength fumigation should be effected if paratyphoid is diagnosed. Dispose of the infected birds. Recovered birds should not be used for breeding purposes; they may carry and transmit the infective bacteria through their droppings and eggs. Poultry and turkey farmers with a paratyphoid problem should consult state veterinarians and poultry pathologists concerning a preventive program to suit local farm conditions.

POISONING

Chickens and other domestic and wild fowl occasionally suffer from various types of poisoning, the most common of which are listed here. In most instances faulty management can be blamed for losses due to poisoning.

1. Arsenic. Found most often in rat and grasshopper baits. Lead-arsenate used in the spraying of fruit trees may also cause symptoms of poisoning.

2. Copper sulfate. Used with comparative safety as a water disinfectant. Poisoning may result if the drug is given in concentrations greater than 1 part to 2,000 parts of water.

3. Mercuric chloride (corrosive sublimate). Used as a disinfectant for surgical instruments. Chickens should not have access to products containing mercury.

4. Sodium bicarbonate (baking soda). When given in concentrations higher than 0.5 per cent, this otherwise harmless drug may assume toxic proportions. It is not usually recommended for use in poultry flocks.

5. Salt (sodium chloride). Salt poisoning may result from ingestion of brine solution, ice cream salt or freezing salt, fish brine, pickling solution, or salt in the ration in excess of 1 per cent.

6. Strychnine. Rat poisons containing strychnine that are used around poultry houses should be kept out of the birds' reach. Phosphorus used in some rat baits may cause fatalities. Use only those rat poisons that are non-toxic to poultry. (Baits such as Warfarin or Red Squill may be used safely.)

7. Lead. The ingestion of paint products containing lead, or even the eating of buckshot, may cause poisoning and death.

8. Nicotine-sulfate. This drug, used for lice and mite control, may prove toxic to birds if an excessive amount of the fumes is inhaled. When applying nicotine-sulfate, allow for adequate ventilation.

9. Potassium and sodium nitrate. Found in commercial fertilizers. It may be mistaken for common salt or manganese sulfate and accidentally mixed with regular mash.

10. Sulfa drugs. Any of the sulfa drugs are potentially harmful if used

for prolonged periods of time or in larger dosages than recommended. Overmedication can result in great damage to a bird's system, or even in death.

11. Carbon monoxide. Poultrymen using gas, wood, coal, or oil-burning brooder stoves should keep a careful check on ventilation and temperature controls. Poor ventilation or extremely high temperatures may produce symptoms of carbon monoxide poisoning. A drowsy, sleepy brood of chicks showing loss of appetites and nervous spasms may be suffering from carbon monoxide poisoning. (Muscles, liver, and spleen may appear bright red on autopsy.)

12. Disinfectant poisoning. Many cases of disinfectant burns and poisoning are diagnosed by state laboratories each year. Do not place birds in brooder houses that have been freshly sprayed with strong chemical disinfectants. Coal tar products, such as creolin, lysol, and cresol, should be sprayed or applied at least one week before chickens are put in the houses.

13. Plants. Plant poisoning is relatively rare in poultry, especially when the birds have access to other sources of food. However, the plants that may be responsible for poisoning include Black Locust, Corn Cockle, Cottonseed meal (in excess of normal tolerance), Coyotilla, Crotalaria seed, Daubentonia seed, Death Camas, Glottidium seed, Milkweed, Sudan grass, Lupine, Nightshade, Lily of the Valley, Oleander, potato sprouts, and tobacco.

14. Insects. In some sections of the country there have been cases of poisoning caused by the ingestion of the rose chafer, or rose beetle.

Diagnosis: Diagnosis of poisoning is based primarily on a history of the birds having had access to a source of poisonous material. A detailed examination of the intestinal tract may reveal intestinal inflammation or hemorrhage. Symptoms of poisoning may range from droopiness and diarrhea to violent nervous convulsions, paralysis, and death. A complete search should be made for the suspected poison or plant so that the birds may be protected against further exposure. Should the owner suspect willful poisoning of the birds, a complete chemical analysis may be made of the intestinal contents.

Treatment of poisoning in chickens is impractical and, in most cases, hopeless.

FOWL POX

Avian Diphtheria, Canker, Sore Head

A highly infectious disease of chickens, turkeys, and pigeons characterized by the formation of wart-like nodules or scabs on the unfeathered portions of the head and body. The disease may also manifest itself by the appearance of cheesy patches in the mouth and eyes. Outbreaks of pox usually occur during the late fall and winter months.

Cause: A filtrable virus. The disease is spread through direct contact with

infected birds. Flies and mosquitoes that have fed on infected carcasses, may transmit the disease. Cuts and wounds of the head parts, or in the mouth, lead to the rapid spread of fowl pox. Exposure to dampness or drafts, the presence of parasites, or unsanitary surroundings may complicate and retard recoveries.

Symptoms: The first indication of pox infection is the formation of small, yellow blisters on the comb, wattles, dewlap, caruncle, corners of the eyelids, or other unfeathered portions of the body. In serious outbreaks the skin of the feet, tongue, mouth, esophagus, and crop may be affected. The blisters break and leave raw areas, which then form dark brown scabs. Cheesy patches may develop on the mucous membranes of the mouth and upper digestive tract. Pox scabs vary from the size of a pea to that of a hazelnut. (*See Plate 50.*)

Dry pox is limited in its effects to the outer layers of the skin. If there are no complications, this form usually passes within two weeks and causes few deaths. However, there is a serious setback in egg production. *Wet pox* affects the mucous membranes of the mouth. Death by suffocation results from the growth of a cheesy membrane over the larynx. Mortalities may be as high as 50 per cent.

Treatment: Treatment of pox calls for prompt isolation and vigilant nursing of the sick birds. If they are gagging, the cheesy plug lodged in the larynx should be removed, either with the finger or with a pair of small forceps. Birds two to four months old that show no active symptoms although they have been exposed to the disease may be protected with the prompt administration of fowl pox vaccine. Younger birds and birds already in egg production should be vaccinated with the milder pigeon pox vaccine. Follow the manufacturer's directions regarding methods of application and the amount of vaccine required.

Prevention: In areas where the disease is not prevalent, fowl pox outbreaks may be prevented if the avenues of infection are minimized. Discourage visits to the farm by poultry dealers, feed salesmen, and other persons who may have had contact with infected flocks. Consult your county agricultural agent and veterinarian as to the desirability of vaccinating against the disease. A discussion of vaccination techniques and recommendations is on Page 227.

PSITTACOSIS

Parrot Fever, Ornithosis

An infectious and highly contagious disease principally of psittacine birds, such as parrots, parakeets, and lovebirds. Chickens, ducks, pigeons, canaries, finches, and turkeys are also capable of harboring the infection. Psittacosis is transmissible to man! It assumes the form of an atypical influenza or pneumonia and is capable of causing the deaths of affected persons.

Cause: A filtrable virus, *Microbacterium multiforme.* The disease may be transmitted to birds or humans by direct contact with the droppings, nasal discharges, or contaminated feathers of actively infected or carrier birds. Inhalation or ingestion of dust containing the virus particles may also cause outbreaks of the disease. Overcrowded conditions in pet shops, aviaries, or on chicken and turkey farms predispose to the rapid spread of psittacosis. Transmission of the virus through the eggs of diseased birds has been reported and may be the manner in which the disease is perpetuated on the farm.

Symptoms: Clinical symptoms and post-mortem lesions usually are too obscure for an accurate farm diagnosis. Indication of infection in younger birds may include loss of appetite, ruffled and soiled feathers, general weakness, drowsiness, emaciation, and death. In older birds there is, in addition, a drop in egg production and a reduction in the fertility and hatchability of those eggs laid. *A greenish diarrhea* and discharge from the eyes and nose may be observed. The disease may assume epidemic proportions in aviaries and pet shops.

Diagnosis: Should any birds—especially parakeets, parrots, or turkeys—display symptoms that are suspicious of psittacosis, the case should be reported immediately to the nearest public health or livestock sanitary officials. Do not take unnecessary chances with such birds. The disease is highly contagious. And do not attempt a post-mortem examination. Arrange to have your veterinarian submit the carcass or the sick birds to a laboratory for autopsy and serological examination. Consult your state poultry pathologists for advice in handling and preventing psittacosis outbreaks.

PULLORUM DISEASE

Bacillary White Diarrhea (BWD)

An acute, infectious, and highly fatal disease of young chicks and poults. The disease is encountered also in ducks, guinea hens, geese, pheasants, and other wild birds. Although primarily a disease of young, growing stock, pullorum may exist as a chronic ovarian infection in hens. These mature fowl are capable of transmitting the disease to their chicks without displaying symptoms of the infection. Pullorum losses include not only chick and poult mortality, but also stunted birds, decreased egg production, impaired hatchability and fertility, and occasionally acute adult flare-ups and death.

Cause: A bacteria, *Salmonella pullorum.* The disease may be spread in a variety of ways. Of primary importance is the dissemination of the causative bacteria through infected eggs laid by carrier hens. Chicks or poults hatched from eggs laid by pullorum carriers are infected at birth. The infective organisms also may be spread at the time of hatching, with entire incubators being exposed to the bacteria carried only by a few infected chicks. The bacteria are spread by the action of the incubator fan and are found in the down

and other materials of contaminated birds and eggs. Pullorum bacteria also are found in the droppings of infected birds. Unsanitary conditions, overcrowding, drafts, chills, poor ventilation, faulty or inadequate diets, or high brooder temperatures will predispose to outbreaks of pullorum if the bacteria are on the premises. Other sources of infection include contaminated chick boxes; brooding units that have housed infected birds and have not been thoroughly disinfected; wild animals and birds carrying the infection from one farm to another; visitors or salesmen who have been in contact with the disease; and poultry dealers who visit the farm with infected crates or trucks.

Symptoms: (in baby chicks and poults) In young birds, pullorum manifests itself in the form of an acute and highly fatal septicemia, or blood poisoning. Chicks may die suddenly during the first two weeks of life having shown only the slightest evidence of illness. The young birds have a tendency to huddle together. They prefer to remain under the hover although brooder temperatures are sufficient to maintain a comfortable warmth throughout the room.

As the disease progresses, the chicks seem drowsy and indifferent to their surroundings. They pick at their food and eat little. Sick birds stand around with their feathers ruffled and their eyes closed. They emit peculiar, shrill cries or chirps of pain, especially when attempting to defecate. Droppings may be sticky, white, and foamy, but they are sometimes brown. The excreta may stick to the down around the vent pasting it so the chick cannot pass its droppings. Labored breathing, unthriftiness, and general weakness are other symptoms associated with pullorum. Chicks infected in the egg show symptoms soon after hatching and may die within one or two days after brooding begins. Chicks infected in the brooder house may not show symptoms for seven to 20 days or longer. Mortalities are highest between the fifth and tenth days of brooding and may run to more than 50 per cent of the brood.

Symptoms: (of adult fowl) No outward symptoms are noticed in chronically affected adult fowl. Should an acute break of pullorum occur in older birds, symptoms may include general weakness, depression, a greenish-brown diarrhea, pale and shrunken combs, and a variable mortality rate. In most cases pullorum disease in older birds is confined to a chronic infection of the ovary.

Diagnosis: Chicks one to five days old usually show no visible lesions on autopsy. A bacteriological examination of their blood and internal tissues must be made to establish a positive diagnosis. Older chicks frequently have small grayish nodules in the heart and gizzard muscles, in the lungs, and sometimes on the outer surface of the intestines. White specks of dead tissue may be seen on the liver. Unabsorbed, discolored remnants of yolk material are sometimes present in the abdominal cavity. The ceca of diseased chicks may be filled with a hard yellow core. Changes in adult birds are usually

confined to the ovaries. The yolks in process of formation are irregular in shape and sharp in outline, shrunken, hard, and brown or green in color. Some of the yolks may contain a dark fluid. Blood from infected adults will show a positive agglutination when subjected to various pullorum tests. Do not rely on home methods of diagnosis. Pullorum disease is best identified by a trained bacteriologist or pathologist.

Three different forms of the agglutination test are used: the long method, or tube test; the rapid serum test; and the stained antigen, rapid whole-blood test. All three methods may be considered equally reliable, but the long method and the rapid serum test are usually performed only in the laboratory. The stained antigen, rapid whole-blood test is used almost exclusively in the field. All three tests should be performed by technically trained personnel. The rapid test involves mixing together, usually on a white tile or glass plate, a drop of stained pullorum antigen and a drop of whole blood taken from the chicken's wing vein. If the bird is infected with pullorum the antigen quickly clumps together into separate violet-colored particles surrounded by clear spaces. If the bird is free from pullorum, the mixture remains homogeneous and clear.

Treatment: There is no effective cure for pullorum disease. Various drugs, such as furazolidone, sodium sulfamerazine, sulfamethazine, or sulfaquinoxaline, may be added to the feed or drinking water for two to four days. These drugs will help to reduce mortality; they will not destroy all the pullorum bacteria. The treated birds may remain as active carriers capable of transmitting the disease to both healthy growing and adult birds. Recovered birds should not be saved for breeding; they should be disposed of when they reach market weight or at the end of the laying year.

Disinfect all brooders, water and feed troughs, and other equipment before bringing in newly hatched chicks. Increased brooder heat, improved ventilation and sanitation, and uncrowded conditions will help keep pullorum losses at a minimum.

Recommendations for hatchery sanitation in the control of pullorum disease are given in the United States Department of Agriculture Bulletin Number 1652. They include the following points:

1. Egg trays, nursery trays, and other readily removable parts should be taken out and scrubbed with a 2 per cent commercial lye solution. (*Steam cleaners may be used to advantage in disinfecting incubators and other hatchery equipment.*)

2. Chick down, droppings, and shell fragments should be removed from the incubator with a brush or vacuum cleaner, and the interior of the machine should be sprayed with a 5 per cent formalin solution. The incubator then should be left closed for at least two hours to permit the formaldehyde gas to penetrate all parts of the apparatus.

3. Fumigation of the incubator room may be accomplished by wetting

thoroughly the exposed surfaces with a 5 per cent solution of formalin and then leaving the room closed for 12 hours *at a temperature not below 60 degrees F.*

Additional information on disinfection and incubator fumigation will be found on Page 130.

Prevention: The most important step in the prevention of this disease is to buy chicks or poults from flocks certified as "U.S. Pullorum Clean" or "U.S. Pullorum Passed." Under the National Poultry Improvement Plan, which is administered by state agencies in cooperation with the Agricultural Research Service, United States Department of Agriculture, there are two pullorum control and eradication classes. They are:

1. *U.S. Pullorum Passed.* In this class, no reactor may be found on any test. All birds five months of age or older must be tested within the testing year immediately preceding the date of sale of hatching eggs or chicks.

2. *U.S. Pullorum-Clean.* No reactors may be found on either of *two* consecutive tests not less than six months apart, or on three consecutive tests not less than 30 days apart. The last test must be made within the testing year immediately preceding the date of sale of hatching eggs or chicks. All birds over five months of age to be used as breeders must be tested.

Having started with Pullorum Clean or Pullorum Passed chicks, avoid personal contact with infected birds and do not bring onto the farm crates, used feed sacks, or other material or objects that may have been in contact with diseased birds. No other special devices, drugs, or procedures are required once adult carriers have been eliminated from the flock and remain excluded.

An individual poultryman who wishes to have his flock tested for pullorum may participate in the National Poultry Improvement Plan by complying with the preliminary requirements in his state. Application should be made to the official state agency, the address of which may be obtained from your county agent, State Agricultural Extension Service, State Department of Agriculture, or the Agricultural Research Service of the United States Department of Agriculture. (*See Addresses, Page 229.*) Those who do not wish to participate in the plan may have their flocks tested privately by applying to their state veterinarian or agricultural experiment station, which is affiliated with the state agricultural college. One also may call upon a practicing veterinarian to do the testing.

INFECTIOUS SINUSITIS

Swell Head, Air Sac Infection

A chronic, infectious condition of turkeys, characterized by inflammation and swelling of the sinuses and filling of the sinus passages with a gelatin-

like substance. Infection of the air sacs and pneumonia are complications of this disease.

Cause: A filtrable virus. The condition is aggravated by undue exposure to drafts, winds, or dust. Poults receiving insufficient amounts of vitamin A are particularly susceptible to sinusitis attacks. The virus also is believed to be identical with the one causing chronic respiratory disease in chickens.

Symptoms: Flocks affected with sinusitis suffer little mortality. However, the sick birds fail to make normal weight gains and the result is a serious loss of revenue at market time. In the first stage of the disease, the birds will be noticed shaking their heads and trying to clean their clogged nostrils on the feathers of the wing. There is a discharge, which is clear and watery at first but later thickens, from the eyes and nose. The eyes may be swollen shut. Food consumption declines among those birds whose sight is impaired. The obstruction of the nasal passages brings on labored breathing. If the infection spreads to the air sacs or lungs, coughing spells may be noted. Emaciation, pneumonia, and death may result. Infectious sinusitis may be confused with nutritional roup, a condition encountered in flocks receiving too little vitamin A.

Diagnosis: In addition to the symptoms described, an autopsy will reveal the thick, gelatin-like exudate in the sinuses and a cheesy covering over the air sacs. The lungs may be congested and inflamed.

Treatment: The fluid in the swollen sinuses should be withdrawn with a hypodermic syringe with a 16 or 18-gauge needle attached. The needle is inserted into both sinuses and the inflammatory fluid drawn into the syringe. With the needle still in place, a clean syringe containing 1 cc. of a 4-per-cent silver nitrate solution is placed onto the needle and the contents injected into the sinus. The tissues are then gently massaged to assure even distribution of the drug. Streptomycin also may be used to treat this condition. The sinuses need not be drained prior to injection of the drug. The streptomycin should be diluted according to the manufacturer's instructions and 150 milligrams injected into each sinus passage. Birds showing symptoms of air sac involvement may receive the injection in the dewlap.

Antibiotics such as chloromycetin, aureomycin, and terramycin have proved effective in reducing losses from infectious sinusitis. The drugs may be placed in the feed or drinking water at the treatment level recommended by the manufacturer (usually from 100 to 150 grams per ton of feed). Antibiotics should be given to the ailing birds for seven to 14 days. Medication should be supported by stimulation of the birds' appetites with wet mashes containing feeding oils or sprouted green feeds. Special bacterins and vaccines are of little or no value in treating or protecting birds against infectious sinusitis.

Prevention: Sinusitis may be spread from sick to susceptible birds through the discharge from the nose and eyes. Transmission of the virus-like organ-

ism through the eggs of infected hens has been reported. Segregation of young birds from older toms and hens is important. Should symptoms of the disease appear, get a laboratory diagnosis as soon as possible. In the meantime remove visibly affected birds and keep them isolated from healthy members of the flock. The streptomycin injections either in the sinuses or dewlap should be given only to those birds showing respiratory symptoms or swollen sinuses. The recommendations listed on Page 175 for the prevention of chronic respiratory disease apply to the control of infectious sinusitis.

STAPHYLOCOCCOSIS

Staphylococcic Arthritis, Synovitis

An inflammatory condition of the joints caused by the pus-producing bacterium, *Staphylococcus aureus*. The disease also may appear as an acute "blood poisoning" causing many deaths. The organism gains entrance to the body through wounds and injuries, or it may be introduced through unclean instruments used to perform such operations as dubbing and caponizing.

Symptoms: A sudden drop in appetite is noticed. The birds appear droopy and listless and have difficulty in walking or moving their wings. The joints are swollen, hot, and tender. There often is a sulphur-colored diarrhea, particularly in turkeys that are affected. In acute attacks death may overtake the birds two or three days after the first symptoms have appeared. Approximately 50 per cent of the flock may be sick, and half of these may succumb to the infection. Chronic cases will sit around on their hocks most of the time, moving only with difficulty. Recovery from chronic attacks usually takes two to three weeks. Many birds that have "recovered" end up as hopeless culls. Staphylococcic infections may localize in the pad of the foot and cause a painful swelling. This condition is known as bumblefoot. (*See Page 170.*)

Diagnosis: Swollen joints are common with this infection. The joints are filled with a cloudy, thick, and yellowish fluid or pus. The tendon sheaths may be covered with a cheesy substance. The sudden and simultaneous appearance of swollen joints and lameness in a large number of birds is indicative of this condition. Perosis, or slipped tendon disease, in its early stages may resemble staphylococcosis. But the typical bowing of the legs and evidence of the slipped tendon are not found in the latter ailment. Other conditions that may produce lameness are gout, tuberculosis of the joints, range paralysis, bumblefoot, and localized cholera infections. The Diagnostic Chart on Page 152 lists some of the characteristic differences between these diseases. Diagnosis may be confirmed by isolation and identification of the "staph" bacterium by the poultry pathologist.

Treatment: Unless arthritic birds have exceptional value as breeders or show birds, they should be segregated from the rest of the flock and dis-

posed of at an early date. Treatment may include the use of sulfathiazole, sulfamethazine, penicillin, aureomycin, terramycin, or other antibiotics or sulfa drugs in the feed or drinking water. These drugs will help lessen the severity of the infection. A rigid program of sanitation should accompany whatever method of treatment is decided upon.

Prevention: Sanitation, especially during caponizing, dubbing, or other operations, will prevent many outbreaks of staphylococcic infections. As a rule domestic birds are fairly resistant to wound infections. However, there is always the first and costly exception. Precautions should be taken to minimize contamination of instruments used in surgery or treatment. Soak drug implanters or injectors and other instruments in a mild disinfectant before and during their use. Remove sharp edges and projections on roosting bars, for their presence may result in breast injuries and deformities or lead to infection with the staphylococcic organism.

Note: A new ailment characterized by lameness and swelling of the hock, wing, and other joints of the body has been reported in young growing birds. The reluctance of the birds to move about because of the pain results in decreased feed consumption with a subsequent loss of condition. Post-mortem examination reveals a jelly-like material in the enlarged joints. The cause of "enlarged hock disease" is as yet unknown. For further information, as it becomes available, consult the poultry pathologist at your state college or university.

STREPTOCOCCOSIS

Apoplectiform Septicemia

A rapidly fatal blood poisoning of chickens, turkeys, pigeons, and other fowl caused by the bacterium, *Streptococcus capsulatus gallinarum*. The condition produces few, if any, noticeable symptoms. There may be depression, drowsiness, and loss of appetite. The birds stagger and collapse shortly before death. The disease is not commonly found on commercial poultry farms.

Diagnosis: Birds suspected of having streptococcosis should be brought to a poultry laboratory for autopsy and bacteriological examination: Post-mortem findings resemble those of various other acute bacterial infections. Gross lesions may include hemorrhagic areas under the skin of the breast and neck and a bloody fluid that fills the sac around the heart. And swellings of the liver, spleen, and kidneys, and the formation of a thick, yellow membrane around the liver may also be seen.

Treatment and Prevention: The use of sulfamethazine, sulfathiazole, or the antibiotics (terramycin, aureomycin, penicillin) in the feed or water may prove of some value. However, before any treatment is undertaken, a laboratory confirmation of the condition should be obtained. Do not use the drugs for more than a week. Treatment should include strict culling of affected birds and careful attention to sanitation.

The use of protective vaccines is not recommended. Avoid the purchase of "started" or adult birds as flock replacements. Carriers of this and other diseases, although they may show no visible symptoms, may be capable of transmitting the infections to susceptible birds.

THRUSH

Moniliasis, Sour Crop, Mycosis

An infectious disease of the mouth, crop, esophagus, and proventriculus of young chicks, pigeons, turkeys, and geese. Thrush is caused by a fungus, *Monilia albicans,* and is transmitted through the droppings of infected birds. The condition is characterized by dirty-white or yellowish patches on the tissues of the crop and other parts of the upper digestive tract. A slimy, putrid discharge from the mouth, as well as depression, loss of appetite, and stunted growth are indicative of thrush.

Diagnosis: Thrush may be diagnosed on post-mortem examination by the finding of the white or yellowish sores on the membranes of the *crop,* mouth, esophagus, and proventriculus. A sour smell is given off by the watery contents of the crop. Confirmation of the diagnosis may be made on bacteriological examination and culture of the lesions for evidence of the fungus.

Treatment: Improved sanitation and prompt, thorough cleaning and disinfection of feed and water containers is essential to the control of thrush. The wisest, most expedient course of action is to prepare the birds for early marketing. However, until they can be disposed of, treatment with copper sulfate should be started. A stock solution may be made by dissolving one-half pound of copper sulfate (*blue stone*) to one gallon of soft or boiled water. Store the mixture in glass or earthenware containers. Using the non-metallic containers, place 4 level teaspoonfuls of the stock solution in every gallon of the regular drinking water. The treated water should be put in front of the birds every other day for seven to ten days.

Prevention: Thrush is associated with overcrowding, faulty nutrition, and lack of sanitation. Poor environment may weaken a flock so that it becomes susceptible to outbreaks of this disease. Thrush, and other filth-borne diseases, can best be prevented with improved management and sanitation.

TUBERCULOSIS

A chronic, infectious and wasting disease affecting practically all species of domesticated and wild birds. The disease is characterized by a gradual and progressive loss of weight and by the formation of nodules, or tubercles, in various organs and tissues of the body. Diseased fowl discharge great quantities of the infective bacilli in their droppings. These bacilli constitute the greatest source of infection for young stock.

Cause: A bacteria, *Mycobacterium tuberculosis avian.* Tuberculosis may be brought to the farm by infected adult birds purchased as replacement stock. Mice and rats and wild birds may carry the infection from one farm to another. Carcasses of birds that have succumbed to the ailment must be disposed of properly or they become a perpetual reservoir of infection.

Avian tuberculosis is transmissible to members of the swine family. Separation of the swine and poultry projects is essential to a successful tuberculosis control program.

Symptoms: Tuberculosis, which may be acquired at any age, usually takes a great deal of time to wear down the body's resistance. Outward symptoms may not appear until the birds are well over a year old. At this time many birds in the flock may show signs of emaciation or "going light." If these birds are handled, one may observe that little or no flesh remains, particularly in the region of the breast. Other symptoms of this infection may be general depression; lameness; swollen joints; a pale, dry, and withered comb and wattles; and frequently a greenish or yellow diarrhea. Appetites may remain normal until death overtakes the birds.

Diagnosis: An autopsy will reveal typical lesions, which consist of pearl-like nodules ranging in size from a pin head to a pea or larger. These hard, yellow lumps are most often seen in the spleen, liver, kidneys, ovaries, intestines, and joints. (*See Plate 51.*) The spleen and liver are almost always affected. Yellow or white gritty centers are found inside of the nodules, or tubercles. Some of the larger lesions are filled with pus. In some prolonged cases, all parts of the body may contain the tuberculous lesions. Bacteriological smears of the suspected nodules will show the presence of the tubercle bacilli. The lesions may sometimes be confused with those of big liver disease (*See Page 161*) and blackhead in turkeys. (*See Page 164.*)

Tuberculin Test: The intradermic tuberculin test offers an accurate means of detecting tuberculosis in living birds. The testing product, tuberculin, is injected into one wattle of the suspected bird. If the bird has the disease, the wattle will swell up to five times its normal size within 48 hours. The uninjected wattle serves as a basis for comparison. Birds in the advanced stages of infection may be so weakened by the disease that they cannot muster sufficient antibodies to produce a reaction to the tuberculin. Fowl in the early stages of the disease may not have developed enough antibodies to elicit a positive response. However, the presence of several positive reactors is a strong indication that tuberculosis exists in the flock. (*See Plate 52.*)

Treatment: There is no method of treating avian tuberculosis. The only method of control is to slaughter those birds suspected of having the disease. Birds that react positively to the tuberculin test and those suspected on the basis of clinical symptoms should be disposed of immediately. In cases where tuberculosis is widespread, it may be necessary to depopulate in order to bring the disease under control.

Prevention: Because tuberculosis develops so slowly, birds up to about 18 months of age are not likely to be active carriers of the infection. If hens are disposed of at the end of their first laying year, transmission to younger birds will be minimized. An adequate system of maintaining pullets will do much to reduce tuberculosis within a flock. After the birds are disposed of, poultry houses should be cleaned and disinfected thoroughly before new stock is introduced. Runways should be used for one year only, then ploughed up and planted to a crop before being used again by chickens. The tuberculosis bacillus may remain alive and virulent for two years or longer in dark, moist, protected places. The importance of sanitation is obvious. Do not allow the birds to have free access to the entire farm; instead, house or fence them in. *In particular, do not allow swine and chickens to mix. Pigs are susceptible to avian tuberculosis and they not only may contract the disease themselves from the birds, but they also may reinfect the chickens.*

FOWL TYPHOID

An acute, infectious, and septicemic disease affecting chickens, turkeys, ducks, pheasants, and guinea hens. Fowl typhoid strikes suddenly and may cause death in as many as 20 to 75 per cent of the infected birds.

Cause: A bacteria, *Salmonella gallinarum*. The organism is closely related to the bacteria that causes pullorum disease. The mode of transmission is essentially the same for both infections. Fowl typhoid bacteria may be found in the discharges from the nose and mouth, and in the droppings of infected birds. The disease is often spread by fecal contamination of feed and water supplies. Insects, flies, rodents, and wild birds have been incriminated as spreaders of the infection. Typhoid infections may be egg-borne, the bacteria being found in the eggs that are laid by carrier hens.

Symptoms: Fowl typhoid primarily affects older birds. Quite often the disease will strike without warning. Birds that apparently were in good health just a few hours before may be found dead under the roosts. Usually, there will be evidence of drowsiness, depression, and weakness. The affected birds lose interest in food, but show increased thirst. A greenish diarrhea may be present. The comb and wattles are dried, pale, and anemic. (*See Plate 53.*)

Diagnosis: Autopsy of typhoid carcasses may reveal an enlarged liver and spleen. The liver has a green sheen with bronze to mahogany streaks running through it. Tiny gray spots may be scattered throughout the liver, indicating death of the tissues. Necrotic areas also may be seen on the surface of the heart and intestines. Typhoid-infected birds show a severely inflamed intestinal tract that is filled with large amounts of bile-stained mucus and pus. The abdominal cavity may be covered with yolk material that appears half cooked. A bacteriological examination of the blood and tissues is

necessary in order to eliminate the possibility of cholera and pullorum infections.

Treatment: Diseased fowl should be prepared for market and sold as soon as possible. Drugs may be used to curtail losses, but recovered animals must be disposed of at an early date. They should never be kept for breeding purposes. Sulfamethazine, sulfamerazine, sulfaquinoxaline, and furazolidone will not cure typhoid infections, though they will alleviate the symptoms temporarily and should prevent excessive losses. Recommendations for controlling the disease are as follows:

1. Kill off birds that are visibly ill and dying. Burn or bury all typhoid carcasses.
2. Completely isolate sick birds from others on the premises. Separate attendants for the diseased and healthy pens is recommended to prevent the disease from spreading.
3. Use sulfaquinoxaline, sulfamerazine, sulfamethazine, or furazolidone to control losses in affected pens. Rigidly cull the sick birds at regular intervals.
4. Clean walls, perches, and nests with a solution of 1 pound of lye in 6 gallons of hot water.
5. Clean dropping boards every day during the course of the disease. Spread lime on the floor to discourage the picking up of contaminated feeds and litter.
6. Clean out waterers and feeders daily. Wash with the lye solution and follow with lysol or quaternary ammonium compound sprays or washes.
7. Chlorine, potassium permanganate, or quaternary ammonium compounds may be added to the drinking water as an extra precaution; however these solutions are unnecessary if frequent water changes are made.
8. Disinfect your shoes and equipment and change to clean clothing when going from infected quarters to clean quarters. If possible, feed and care for the healthy birds before attending to sick flocks.
9. As soon as mortalities have subsided and the acute stages of the disease have passed, sell the affected pen or pens for meat.
10. Follow the sale of birds with a complete cleaning and disinfection of quarters and equipment before adding new birds to the premises.
11. If birds are kept through their laying year, cull rigidly and constantly. The pullorum plate test can be used each month until two consecutive, negative tests are recorded. Pullorum antigen tests will detect both pullorum and typhoid carrier birds. Reacting birds should be disposed of.

Vaccination. Some poultry farmers vaccinate their birds against typhoid. In most instances, this is a time-consuming and unnecessary venture. The practical method of typhoid prevention consists of purchasing chicks from reputable hatcheries and instituting measures for sanitation and proper management.

VENT GLEET

Cloacitis

A non-infectious condition of chickens characterized by a marked inflammation and ulceration of the vent and cloaca. There is a foul smelling diarrhea. Birds affected with vent gleet are susceptible to blowouts, or prolapse of the oviduct, and are apt to be picked to death by their penmates. The exact cause of vent gleet is unknown. Immediate slaughter is recommended for birds suffering from this condition. If slaughter is delayed, a loss of flesh may lessen the value of the bird. Should treatment be preferred, daily swabbing of the cloaca with a 3 per cent silver nitrate solution or the use of tyrothricin or penicillin ointments may prove effective in some cases.

WATER BELLY

An accumulation of fluid in the abdominal cavity. Water belly may be brought on by abdominal tumors, especially those associated with the avian leukosis complex. (*See Page 161.*) A diseased condition of the oviduct also may bring on symptoms of water belly. Birds thus affected should be slaughtered at once. Human consumption of the bird's flesh is not advisable.

VACCINATION AGAINST NEWCASTLE DISEASE, BRONCHITIS, LARYNGOTRACHEITIS, AND FOWL POX

The prevention of virus diseases through vaccination plays an important part in progressive poultry health programs. The diseases for which vaccines are most generally used are Newcastle disease, fowl pox, and laryngotracheitis. In some areas, inoculation against infectious bronchitis is carried out. The material that follows is, of necessity, general in scope. No set of recommendations can be formulated that will apply to all farms under all conditions. In certain states the use of some live virus vaccines is prohibited by law. Often in sections of the country where a specific disease is not widespread, it is unwise to introduce the infection by way of vaccination. The farmer considering the use of live virus vaccines for the first time should consult his veterinarian or poultry pathologist at his state agricultural college regarding the choice of vaccines and vaccination methods.

Vaccination with the live virus vaccines ordinarily is advocated under the following conditions:

1. On farms where pox, laryngotracheitis, infectious bronchitis, or Newcastle disease have occurred in the past, and particularly where recently recovered birds are still on the premises.
2. On farms located in highly concentrated poultry areas where vaccination against these diseases is generally practiced.

3. On farms where susceptible birds are to be added to a flock that has recently recovered from an outbreak of the disease. The new birds should be vaccinated at least three weeks before they are added to the flock.

4. On farms where recovered birds are to be added to susceptible, non-vaccinated flocks.

5. On farms where emergency measures are necessary to control an outbreak of the disease. This type of vaccination should be carried out only on the advice of a poultry pathologist or veterinarian.

GENERAL VACCINATION RECOMMENDATIONS

1. Vaccinate all susceptible replacement birds at the same time—when the youngest birds to be vaccinated are at least four weeks old. If this program is not practical, segregate vaccinated birds from younger, non-vaccinated broods and immunize each successive batch of chicks as they come of age.

2. Use vaccines exactly as directed by the manufacturer or your veterinarian. Most vaccines contain live viruses, which may cause unfavorable reactions and even help spread the disease if not properly handled.

3. Vaccines are subject to rapid deterioration. Place vaccination materials in refrigerators, with temperatures not to exceed 45 degrees F., until they are to be used. Do not purchase old vaccines. Expiration dates are listed on cartons.

4. Do not prepare the vaccine until you are ready to use it. Prepared vaccines should be used within four hours after they have been mixed. Mix vaccines according to the manufacturer's directions. Keep vaccines out of direct sunlight, since sunlight tends to weaken or destroy the virus. If vaccination of the flock is to be carried out on a hot day, the vaccine should be kept cool in an insulated food bag or a wide-mouthed jug.

5. Mix vaccine away from poultry houses. One man should prepare and administer the vaccine. And this person should avoid handling the birds more than is necessary during the vaccination procedure.

6. Sacrifice speed for accuracy. A poorly vaccinated flock is in greater danger than a non-vaccinated flock.

7. Do not mix two different vaccines together other than Newcastle and bronchitis vaccines. Despite limited reports favoring mixing of Newcastle and fowl pox vaccines, the procedure is not advisable under most conditions. Time-saving devices have a habit of backfiring and causing more losses in vaccination reactions than the short cuts could ever pay for. Laryngotracheitis and fowl pox vaccines, because there is a difference in the site of inoculation and period of reaction, may be given at the same time safely. If this combination is used, it should be given when the birds are eight weeks of age or older.

9. Carefully burn unused, prepared vaccines and used cartons, needles, and brushes at the end of the day. Do not keep unused portions of vaccines overnight. There may be a serious decrease in immunizing power and faulty "takes" may result. If automatic syringes are used for fowl pox or Newcastle wing-web vaccinations, they should be sterilized by boiling after they are used.

10. Keep vaccinated and non-vaccinated birds separated for two to four weeks. (Minimum of two weeks for laryngotracheitis and Newcastle disease, and four weeks for fowl pox.)

11. Do not vaccinate on cold, rainy days. *Do not vaccinate flocks suffering from coccidiosis or other parasitic, virus, or bacterial infections.* Undue losses may result if this rule of vaccination is ignored. If there is danger of a coccidiosis break, the flock may be given any one of the suitable sulfa or other anti-coccidiosis drugs for one or two days before and for seven days after vaccination. (*See Page 176.*)

12. All vaccinations should be completed at least one month before the flock is due to start laying.

13. Watch for the drop in feed consumption that follows almost all vaccinations. Stimulate appetites with feedings of wet mash, pellets, succulent green feeds, or milk products. High-level antibiotic mashes may be given for two days before and for seven to ten days after the vaccination of the flock. The usual amount is 100 to 200 grams per ton of feed. It may be added to the drinking water in the amounts directed by the manufacturer.

14. With rare exceptions, the vaccine manufacture's directions should be followed explicitly. Time-saving and vaccine-stretching devices may prove expensive in the last analysis. *When possible, place your vaccination program under the supervision of a poultry pathologist or a veterinarian familiar with poultry diseases.*

Newcastle Vaccination with Live Virus, Wing-Web Vaccine

Age to Vaccinate	Four weeks or older. Do not use on laying birds. Can spread to non-immune birds. Day-old chicks may be inoculated with a drop of the mild virus vaccine placed in the nostril or on the eye. Revaccination four weeks before laying begins with wing-web, live virus vaccine is then recommended.
Method of Vaccination	Double needle pushed through web of the wing.
Reaction or "Take"	Slight swelling over area. Cough, sneeze, nervous symptoms, drop in feed consumption in 7

	to 10 days. One to 3 per cent mortality. Laying birds show 60 to 90 per cent drop in egg production.
Multiple Vaccinations	Best results when given alone. Pigeon pox and laryngotracheitis vaccines may be given in emergencies. Fowl pox inoculation not generally recommended with Newcastle, live virus vaccine.
Lapse Between Newcastle and Other Vaccination	Two weeks minimum. Best to wait longer if possible.
Approximate Duration of Immunity	Six months to one year or longer.
Revaccination Necessary	Yes, if birds are kept for second laying year or for breeding. Vaccinate during molting period.
Recommendations for Management	Feed wet mashes, antibiotics, and succulent green feeds to offset drop in feed consumption. Wait three weeks after vaccination of adult birds before saving hatching eggs. Avoid getting vaccine in a person's eyes.

NEWCASTLE VACCINATION WITH LIVE, MILD, OR MODIFIED VIRUS VACCINE

Age to Vaccinate	Three to four days or older. Best to wait until chicks are three weeks of age. May be used on day-old chicks and hens in production.
Method of Vaccination	*Individual treatment:* One drop of vaccine placed on nostril or in the eye of the bird. *Mass treatment:* Spray, dust, or water vaccines. Follow manufacturer's directions.
Reaction or "Take"	Mild symptoms. Coughing, sneezing, drop in appetite in five to seven days or sooner. Symptoms disappear in two weeks. No nervous symptoms. Little or no mortality. Laying birds may suffer 10 to 20 per cent drop in egg production.
Multiple Vaccinations	May combine with mild bronchitis vaccine using eye, nostril, dust, water, or spray method of inoculation. Follow manufacturer's recom-

	mendations. Pigeon pox or laryngotracheitis vaccines may be used at same time on chicks four weeks or older.
Lapse Between This and Other Vaccinations	Best to wait two weeks or more.
Approximate Duration of Immunity	Between two and six months. Varies according to type of vaccine used and age of birds vaccinated.
Revaccination Necessary?	Yes. Birds to be kept as layers should be revaccinated one month before egg production starts. May use wing-web, intranasal, intraocular, or mass treatment. Follow manufacturer's directions.
Recommendations for Management	Watch for drop in feed consumption. Stimulate appetites with wet mash, pellets, or antibiotics. Do not vaccinate flocks suffering from parasitism or other infections. Water vaccines should be placed in fountains or jars that have been cleaned of disinfectants or water sanitizers. The water should be cold and the birds water-starved for two to three hours before treated water is put before them.

Newcastle Vaccination with Killed Virus Vaccine

Age to Vaccinate	May be used on birds any age. Chicks one to seven days old and layers can be safely inoculated. Best to use at ten to 14 days of age.
Method of Vaccination	One or two intramuscular injections. Follow manufacturer's directions.
Reaction or "Take"	Little or no reaction. Laying birds suffer drop in egg production up to 10 per cent.
Multiple Vaccinations	Laryngotracheitis or pigeon pox vaccines may be given in emergencies.
Lapse Between Killed Virus and Other Vaccinations	Complete immunity is not developed for two to three weeks.
Approximate Duration of Immunity	Variable. Usually expected to afford protection for two to four months.

Revaccination Necessary?	Yes. If birds are to be kept as breeders or layers, vaccination with live virus is recommended, or revaccination with killed virus in states where live virus vaccines are prohibited.
Recommendations for Management	Short duration of immunity discourages use of killed virus for birds to be kept for more than four months.

VACCINATION FOR LARYNGOTRACHEITIS

Age to Vaccinate	Six weeks to four months of age. Avoid vaccinating too close to laying time. In some congested poultry areas, vaccination at four weeks may be necessary to protect broilers until market time. Consult your veterinarian or state poultry pathologist.
Method of Vaccination	Brush applied to cloacal membrane. The use of a needle is not recommended. (*See Plates 54 and 55.*)
Reaction or "Take"	Reaction is localized to vaccination area. Cloaca swells, cherry red in color. Check for "takes" four to five days after vaccination. May be some drop in feed consumption at that time.
Multiple Vaccination	Laryngotracheitis may be safely given at the same time as fowl pox *or* Newcastle live or dead virus vaccines.
Lapse Between Laryngotracheitis and Other Vaccinations	Ten days. Wait two weeks or longer if possible.
Approximate Duration of Immunity	Immunity is lifelong if vaccination is handled correctly.
Revaccination Necessary?	No.
Recommendations for Management	Check all birds for "takes" and revaccinate those not showing positive reactions. Feed wet mash and antibiotics to stimulate appetites five days after vaccination.

Bronchitis Vaccination with Live, Mild or Modified Vaccine

Age to Vaccinate	Three to five days or older. Best to wait until chicks are three weeks of age. May be used on day-old birds. Not recommended for birds in production. Finish vaccination at least four weeks before laying starts.
Method of Vaccination	*Individual treatment:* One drop of vaccine placed on the nostril or eye. *Mass treatment:* Spray, dust, or water vaccines. Follow manufacturer's directions.
Reaction or "Take"	Mild symptoms may be noted in 24 to 48 hours. Coughing, sneezing, gasping, sniffling, and drop in feed consumption. Symptoms disappear in five days to two weeks. Little or no mortality if birds are otherwise in good health.
Multiple Vaccinations	May combine with mild Newcastle vaccine using eye, nostril, water, dust or spray methods. Follow manufacturer's directions. Consult veterinarian or state poultry pathologist.
Lapse Between This and Other Vaccinations	Best to wait two or three weeks.
Approximate Duration of Immunity	Varies with type of vaccine and age of bird. Birds vaccinated after five weeks of age may be immune for one year.
Revaccination Necessary?	Yes. Birds to be kept as layers, especially if inoculated before the fifth week, should receive booster shots. The last vaccination should be scheduled at least one month before laying starts. Individual or mass methods of revaccination may be used. Birds vaccinated with a virulent or "hot" virus at 10 to 12 weeks of age need not be revaccinated.
Recommendations for Management	Watch for drop in feed consumption. Stimulate appetites with wet mashes, pellets, or antibiotics. Do not vaccinate flocks suffering from parasitism or disease. Water vaccines should be placed in cold water that is free of disinfectants or sanitizing agents. Birds should be

water-starved for two to three hours before vaccine-treated water is placed before them.

Fowl Pox Vaccination with Fowl Pox Vaccine

Age to Vaccinate	Four to 16 weeks. At least one month before birds come into production.
Method of Vaccination	Feather follicle (2 or 3 on thigh) or double needle pushed through the web of the wing. Use stab method for turkeys. (*See Plate 56.*)
Reaction or "Take"	Drop in feed consumption ten days after vaccination. Formation of scabs at inoculation site in seven to 12 days. Scabs fall off in 14 days. (*See Plate 57.*)
Multiple Vaccinations	May be given at same time laryngotracheitis is given. Sometimes used along with Newcastle vaccine, but this is not generally recommended.
Lapse Between Fowl Pox and Other Vaccinations	From 21 to 28 days. Four weeks best.
Approximate Duration of Immunity	If properly administered, immunity in chickens is lifelong. Six to seven months in turkeys.
Revaccination Necessary?	No. Do not use on birds in production. Revaccinate turkeys to be kept as breeders.
Recommendations for Management	Provide warmth and dry quarters for three weeks after vaccination. Feed wet mashes and antibiotics. Revaccinate those birds not showing positive reactions.

Fowl Pox Vaccination with Pigeon-Pox Vaccine

Age to Vaccinate	Broilers 2 to 4 weeks of age on your poultry pathologist's recommendation. Hens in production, to curb an outbreak of pox. Pigeons, after 4 weeks of age.
Method of Vaccination	Broiler chicks: Four to six feather follicles, or needles through web of wing. Mature birds: 20 to 30 open follicles in thigh. Pigeons: Three to six open follicles on breast.

Reaction or "Take"	Swelling of follicles 10 to 12 days in chickens. Slight drop in feed consumption. No interference in laying bird production. Swelling of follicles in pigeons with slight scab formation in seven to ten days.
Multiple Vaccination	Because of the slight reaction suffered, pigeon pox can be given at the time Newcastle or other vaccines are administered.
Lapse Between Pigeon Pox and Other Vaccinations	Complete immunity is not developed for 21 to 28 days.
Approximate Duration of Immunity	Broilers and adult fowl three to six months. Pigeons lifelong immunity.
Revaccination Necessary?	Yes. For birds kept as breeders or layers, revaccinate one month before they start to lay or when they go into seasonal molt. Use fowl pox vaccine.
Recommendations for Management	Do not use on turkeys; use fowl pox only for these birds. The more feather follicles inoculated, the longer the period of immunity. Use weaker pigeon pox vaccine on birds about to come into production, laying birds, and flocks suffering from parasitism, virus, or bacterial disease.

Addresses of State Agricultural Experiment Stations

Agricultural experiment stations study problems relating to the agriculture of the states and publish the results of such investigations. The publications issued by them usually constitute the most authoritative information available on the subjects treated and can be obtained from the director of the station, usually free of charge. The following list gives the post office addresses of agricultural experiment stations in the United States.

STATE	CITY
Alabama	Auburn
Alaska	College
Arizona	Tucson
Arkansas	Fayetteville
California	Berkeley 4
Colorado	Fort Collins
Connecticut:	
State station	New Haven 4
Storrs station	Storrs
Delaware	Newark
Florida	Gainesville
Georgia:	
State station	Experiment
Coastal plain station	Tifton
Hawaii	Honolulu 10
Idaho	Moscow
Illinois	Urbana
Indiana	Lafayette
Iowa	Ames
Kansas	Manhattan
Kentucky	Lexington 29
Louisiana	Baton Rouge 3
Maine	Orono
Maryland	College Park
Massachusetts	Amherst
Michigan	East Lansing
Minnesota	University Farm, St. Paul 1
Mississippi	State College
Missouri	Columbia
Montana	Bozeman
Nebraska	Lincoln 1
Nevada	Reno
New Hampshire	Durham
New Jersey	New Brunswick
New Mexico	State College
New York:	
State station	Geneva
Cornell	Ithaca
North Carolina	Raleigh
North Dakota	Fargo
Ohio	Wooster
Oklahoma	Stillwater
Oregon	Corvallis
Pennsylvania	State College
Puerto Rico	Rio Piedras
Rhode Island	Kingston
South Carolina	Clemson
South Dakota	Brookings
Tennessee	Knoxville 16
Texas	College Station
Utah	Logan
Vermont	Burlington
Virginia:	
College station	Blacksburg
Truck station	Norfolk 1
Washington	Pullman
West Virginia	Morgantown
Wisconsin	Madison 6
Wyoming	Laramie

State Poultry Diagnostic Laboratories

ALABAMA	State Veterinary Diagnostic Laboratory, Alabama Polytechnic Institute, Auburn, Ala.
ARIZONA	Animal Pathology Department, University of Arizona, Tucson, Ariz.
ARKANSAS	Department of Bacteriology and Veterinary Science, University of Arkansas, Fayetteville, Ark.
CALIFORNIA	(6 laboratories. Others under construction.) Poultry Pathological Laboratories, Petaluma, Calif.; 714 S. Santa Anita Street, San Gabriel, Calif.; Balboa Park, San Diego, Calif.; Poultry Disease Specialist, State Office Building, Sacramento, Calif.; Division of Veterinary Science, University of California, Berkeley, Calif.; College of Veterinary Medicine, University of California, Davis, Calif.
COLORADO	Diagnostic Laboratory, School of Veterinary Medicine, Colorado A&M College, Fort Collins, Colo.; Federal Building, Denver, Colo.
CONNECTICUT	Department of Animal Diseases, University of Connecticut, Storrs, Conn.
DELAWARE	Poultry Disease Laboratory, Department of Agriculture, Dover; Branch Laboratory, University of Delaware Substation, Georgetown, Del.
FLORIDA	Veterinarian, Agricultural Experiment Station, University of Florida, Gainesville, Fla.
GEORGIA	Department of Veterinary Pathology, University of Georgia, School of Veterinary Medicine, Athens, Ga.
IDAHO	Division of Veterinary Science, University of Idaho, Moscow, Idaho; State Bureau of Animal Industry, State House Annex, Boise, Idaho.
ILLINOIS	Diagnostic Laboratories, College of Veterinary Medicine, University of Illinois, Urbana, Ill. Also, 2101 South Washington Street, Peoria, Ill.; 114 West Broadway, Centralia, Ill.; Room 206, 999 Exchange Ave., Chicago 9, Ill.
INDIANA	Department of Veterinary Science, Purdue University, Lafayette, Ind.
IOWA	Veterinary Diagnostic Laboratories, Iowa State College, Ames, Iowa
KANSAS	Department of Bacteriology, Kansas State College, Manhattan, Kan.
KENTUCKY	Department of Veterinary Science, University of Kentucky, Lexington, Ky.
LOUISIANA	Department of Veterinary Medicine, Louisiana State University, Baton Rouge, La.
MAINE	Animal Pathology Laboratory, University of Maine, Orono, Me.

MARYLAND	Livestock Sanitary Service, Quantico Rd., Salisbury, Md.; State Board of Agriculture, 130 North Bond Street, Bel Air, Md.; Hagerstown Laboratory, 101 Summit Avenue, Hagerstown, Md.; Livestock Sanitary Service, Winchester Hall, Frederick, Md.; College Park, Md., and Centerville, Md.
MASSACHUSETTS	Department of Veterinary Science, University of Massachusetts, Amherst, Mass.; Poultry Disease Laboratory, Mass. Agricultural Experiment Station, Waltham, Mass.
MICHIGAN	Poultry Pathology Laboratory, Michigan State College, East Lansing, Mich.
MINNESOTA	Veterinary Division, University of Minnesota, University Farm, St. Paul, Minn.
MISSISSIPPI	Veterinary Department, State College, Miss.
MISSOURI	Veterinary Department, College of Agriculture, Columbia, Mo.
NEW HAMPSHIRE	Poultry Pathology Laboratory, University of New Hampshire, Durham, N.H.
MONTANA	(2 laboratories) Montana Veterinary Research Laboratory, Veterinary Department, State College, Bozeman, Mont.; Livestock Sanitary Board, Helena, Mont.
NEBRASKA	Department of Animal Pathology, University of Nebraska, Lincoln, Nebr.
NEVADA	Veterinary Control Service, University of Nevada, Reno, Nev.
NEW JERSEY	(2 laboratories) Department of Poultry Husbandry, New Jersey Agricultural Experiment Station, New Brunswick, N.J.; and Poultry Disease Laboratory, Vineland, N.J.
NEW MEXICO	Poultry Pathology Laboratory, New Mexico College of Agriculture and Mechanical Arts, New Mexico State College, Mesilla Park, N. Mex.
NEW YORK	Department of Pathology and Bacteriology, New York State Veterinary College, Ithaca, N.Y., and branch Poultry Diagnostic Laboratories at 88-90 Prince Street, Kingston, N.Y.; 52 Genesee Street, Warsaw, N.Y.; East Aurora, N.Y.; 6 Country Club Road, Oneonta, N.Y.; Farmingdale, Long Island, N.Y.; and the Duck Research Laboratory, Eastport, Long Island, N.Y.
NORTH CAROLINA	Poultry Disease Laboratory, State College, Raleigh, N. Car.
NORTH DAKOTA	Department of Veterinary Science, North Dakota State College, Fargo, N.D.
OHIO	Department of Poultry Science, Ohio Agricultural Experiment Station, Wooster, Ohio; Pathological Service Laboratory, College of Veterinary Medicine, Ohio State University, Columbus, Ohio.
OKLAHOMA	Department of Veterinary Science, Oklahoma Agricultural Experiment Station, Stillwater, Okla.
OREGON	Poultry Disease Laboratory, Oregon State Agricultural College, Corvallis, Ore.
PENNSYLVANIA	Poultry Disease Diagnostic Laboratory, Pennsylvania State College, State College, Pa.; Bureau of Animal In-

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VERMONT	Department of Animal Pathology, University of Vermont, Burlington, Vt.
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WASHINGTON	Western Washington Experiment Station, Puyallup; Veterinary Department, State College of Washington, Pullman, Wash.
WEST VIRGINA	Department of Agriculture Laboratory, Charleston, W.Va.; Department of Animal Husbandry, University of West Virginia, Morgantown, W.Va.
WISCONSIN	Department of Veterinary Science, University of Wisconsin, Madison, Wis.
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